CURRENT SCIENCE

Vol. IX] APRIL 1940 [No. 4

	Page
A Bureau of Standards for India—I	161
Customs Duty on Laboratory Ware and Scientific Instruments	164
A New X-Ray Effect. By Sir C. V. Raman and Dr. P. Nilakantan	165
The Severe Magnetic Storm of March 24, 1940. By M. R. Rangaswami and N. C. Basu	167
Palæobotany in India	169
Prof. K. S. Krishnan, D.Sc., F.R.S. S. Bhagavantam	170
Letters to the Editor	171
Obituaries:	
Dr. (Miss) C. Minakshi, M.A., Ph.D.	191
Professor R. S. Troup, C.M.G., C.I.E., D.Sc., M.A., F.R.S. (1875–1939)	191
Reviews	192
Pleistocene Geology of India. By D. N. Wadia	200
Silt Indices and Discharge Elements for Regime Channels. C. Gopalakrishnan.	202
The Diamagnetism of the Mobile Electrons in Aromatic Molecules. M. A. G.	204
The Rôle of Chemistry in Forestry	205
The Cretaceous-Eocene Boundary	206
The Place of Geography in National Planning	206
Centenaries.—	
Poisson, Simeon Denis (1781–1840)	207
Science Notes and News	208
Academies and Societies	213
Errata	214

A BUREAU OF STANDARDS FOR INDIA

I

THE need of setting up recognised standards for general convenience in scientific and technical fields was first recognised towards the end of the last century. Standardization was then applied in a limited field and was principally intended to secure accuracy and uniformity in units of measurement and other scientific data. The Bureau International Des Poids et Measures was the first to be inaugurated in 1875 for the purpose by the French Government; the National Physical Laboratory was established in 1889; and the American National Bureau in 1901. In the early stages these institutions served the interests of scientists and engineers who required standardization for purposes of co-relation or discussion and interpretation of scientific and technical data and information. With the increasing recognition of the application of science to industry, the importance of these institutions increased. Also the process of standardization or scientific reduction to well-conceived fundamentals found greater scope in industry, which was accelerated by the economic pressure and competition amongst the manufacturing countries who were keenly appreciative of the unique facilities offered and the economy secured by standardization. Within a decade since the end of the war, no less than twenty-one standardizing bodies were formed in different

countries. To-day this movement has assumed such proportions and importance, that its use can no longer be overlooked by any country that hopes to make a mark in the industrial or scientific field.

The field covered by the subject falls into the two well-defined groups: (*a*) Fundamental or absolute standardization dealing with standardization of units of measurements and allied subjects; (*b*) Industrial standardization with simplification and uniformisation of materials and methods in all branches of industry.

Fundamental standardization, in fact, constitutes an essential part of industrial standardization since the latter cannot be carried out without establishing uniformity and accuracy of units of measurement. But the classification is desirable on account of (1) industrial standards, like scientific hypotheses, only represent the present state of knowledge as applied to industry and are liable to changes and modifications with an advance in technical knowledge and skill. The absolute standards, on the other hand, change less frequently and take into cognisance not only the exigencies in promoting trade and industry but also the progress of the fundamental sciences. (2) The methods employed and outlook adopted in carrying out prolonged, patient and intricate research for establishing and improving fundamental standards, are different from those which determine the preparation of industrial standards. A committee entrusted with fundamental research will find it difficult to issue recommendations until their work is completed to their satisfaction whereas a committee like the British Standards Association, is obliged to accept the industrial point of view and adopt a policy of expediency to meet the immediate requirements of the Industry. (3) Very few industries are, in particular, interested in establishment of general standards or in research of a fundamental character since they are considered to fall beyond the scope of their routine existence. Yet, their influence on the progress of science, the integrity of trade and the advancement of industry are so intimate and effective that they are entitled to the same treatment at the hands of government as is extended to the other services of public utility. (4) The problem of choosing, maintaining or developing primary units and methods in science has grown so wide and so internationally interdependent, that it can no longer be handled in a narrow and restricted way. All the international standardizing bodies like the International Bureau of Weights and Measures, are formed by the co-operation of various governments without whose help and authority they cannot usefully function.

Fundamental standardization includes (*i*) Determination of natural or fundamental constants, *i.e.*, the data regarding the fixed points or quantities in science which constitute the basis of all pure and applied research. Physical constants such as mechanical equivalent of heat, light, electricity, specific densities, atomic weights, heat of combustion and many similar constants, have to be fixed experimentally with great precision. (*ii*) Development, construction and maintenance for purposes of reference, primary and derived standards of measurements which include all essential measurements for expressing quantitatively time, matter, space and energy and their interrelations. (*iii*) Establishment of standard scientific practices. This would involve

such work as for instance, deciding upon proper nomenclatures, definitions of scientific terms, symbols for quantities used, etc., and giving publicity to these so as to inform all those interested in the work.

We can hardly over emphasize the value of such work to science. It builds up a great amount of essential scientific data which serves as basis for experimental science; facilitates a comparative study of the data obtained by various workers in a given field; introduces precision in science and technology and helps to calibrate apparatus and instruments. It secures uniformity of practice in industry and promotes equity and justice in trade. It helps to standardize industrial processes and manufactures and to introduce accuracy and efficiency in their production.

At present every institution or industry in India that requires precision in its measurements is obliged to maintain its own standards for reference in every work. These have to be calibrated from abroad and the process has to be repeated periodically for checking the accuracy of standards so maintained. These calibrated standards or in fact any piece of apparatus imported from abroad is calibrated under conditions not obtainable in India. Difficulty therefore arises regarding reducing these calibrations to Indian laboratory conditions; it is time this country decides upon its own measurement units. The units and measures followed in this country for scientific or technical purposes are mostly borrowed from the West, and these are not directly related to the non-standardized commercial units in vogue in various parts of the country. Further the units of mass, length, volume, etc., are numerous and vary widely in different parts of the country, and often in various trades in the same locality. An attempt at standardizing these national units or nationalise the foreign ones as may be found necessary should be made. The question bears great importance both to science and industry in the country and is likely to involve a considerable amount of intricate and controversial argument.

The suggestion that India also should establish its own standards laboratory was made in 1930 by the Imperial Conference at which the Conference of Standardization was held. It was also suggested that each standards laboratory in the empire should take up research so that fundamental standards could be ultimately referred to the natural standards such as the wavelength of light, and that co-operation should exist in the working of these laboratories. A year later the Sewell Committee appointed by the Government of India to review the working of the Indian Institute of Science, Bangalore, suggested that "there should be no difficulty in obtaining recognition for the Institute as a standardization and testing laboratory if its activities and aims are sufficiently well known and various governments are approached. One such recognition has been obtained. We might, for instance, mention electrolysis, instrument calibration, investigation of surges due to switching and lightning on transmission lines, heating of cables, tests of grounds, insulators and machinery, studies of inductive intereference between power and telephone lines as some of the work which the Institute should be well able to undertake". Since the recommendation was made facilities for new channels of work in this direction are opened by the addition of Department of

Physics and of Chemical Engineering. Also equipment for a standards laboratory is being built up in the Department of Electrical Technology. We think it would be worthwhile comparing the present organization of the Institute with that of the National Physical Laboratory, as the Sewell Committee had done ten years ago.

N. P. L. (England)	*Indian Institute of Science (India)*
1. Physics: Dealing with general physics, determination of physical constants, calibration of physical apparatus, standardization of X-ray and radium.	1. Department of Physics and Department of Pure and Applied Chemistry dealing with Research in pure and applied sciences.
2. Electricity: Dealing with calibration of instruments, research on wireless transmission and electrotechnics.	2. Department of Electrical Technology including (1) communication engineering section, (2) standards room equipment dealing with training and research in electrotechnics and communication engineering and calibration of instruments.
3. Engineering: Dealing with strength of materials.	3. Department of Electrical Technology and its section of mechanical engineering. Also Central Workshop.
4. Metrology: Standardization of weights and measures, clocks, meters, etc.	
5. Metallurgy.	5. Department of Inorganic Chemistry and Department of Chemical Technology.
6. Aerodynamics.	
7. Investigation of ships.	

The idea of starting such a standards laboratory in India is not a new one. Nor will there be much difference of opinion about its disirability, a modest beginning can be made with available resources. It would be interesting to note here that the National Bureau of Standards (U.S.A.) which is the biggest standards organization in the world to-day started in 1901 with a staff of 14 technical men and 9 non-technical men. What is needed in the project is the initiative and a will to work up the idea in spite of apparent difficulties.

CUSTOMS DUTY ON LABORATORY WARE AND SCIENTIFIC INSTRUMENTS

THE Government of India imposes a customs duty of thirty per cent. on laboratory ware and scientific instruments. Whatever may have been the considerations which have led the Government to arrive at this high percentage, we wish to invite their attention to the present attitude taken by the British Government with regard to the import of goods into the United Kingdom for scientific use. On 8th September 1939, the treasury gave notice that they would consider applications for licences to import *free of duty* goods intended to be used in scientific research. The announcement proceeds to advise that such applications which should be addressed to the Secretary, H. M. Treasury, must be made on behalf of educational institutions, hospitals or recognised scientific bodies, including laboratories maintained by individual organisations or consultants, and must be accompanied by a written statement by the responsible professor or director. This statement should indicate the scientific purpose for which the goods are required and justify the claim that a suitable alternative is not obtainable in the United Kingdom. We hope that the Government of India, who have recently adopted a vigorous policy to encourage scientific and industrial research in this country, will consider the question of granting similar concessions for the importation of scientific equipment so essential for the advancement of scientific and industrial research.

A NEW X-RAY EFFECT

BY

SIR C. V. RAMAN AND DR. P. NILAKANTAN

THE discovery by Laue in 1912 of the diffraction of X-rays by crystals and the discovery by A. H. Compton in 1922 of the change of wave-length in X-ray scattering had both a profound influence on our concepts of the nature of X-radiation. Laue's discovery established beyond all question that X-rays are physically of the same nature as ordinary light but of much shorter wave-length, while the Compton effect showed in the clearest possible way that the interaction between X-rays and matter obeys quantum mechanical principles. The new X-ray phenomenon described and illustrated in the present communication has, in its physical nature, something in common with both the Laue and the Compton effects: it is a specular reflection of X-rays by crystals but with a change of frequency explicable only on quantum mechanical principles. Before proceeding to give particulars of the phenomenon, it would appear desirable to make a few prefatory remarks regarding the structure of crystals and the nature of their internal vibrations.

FIG. 1. Laue pattern of diamond showing the new effect

The ideal crystal is an ordered geometric arrangement of atoms or molecules held together in a space-lattice by interatomic forces. The electron density in such a crystal is a periodic function in space expressible as a three-dimensional Fourier series. Each term in this Fourier expansion contains as a multiplying factor the structure-amplitude which is the magnitude of the periodic variations of electron-density occurring as we proceed along the particular direction in the crystal. This same factor determines the amplitude and phase of X-rays reflected by the particular spacing in the crystal in the conditions indicated by the Bragg formula.

The internal vibrations possible in a crystal are of two types. The first type is the acoustic spectrum of elastic waves which traverse the crystal in all directions and range in frequency from zero up to a certain limiting value; these figure in the Debye expression for the specific heat of the solid. The second type consists of the characteristic vibrations of the crystal giving rise to well-defined spectral lines in infra-red absorption or in the scattering of monochromatic light; these appear as Einstein functions in the expression for the specific heat. We are here particularly concerned with the nature of the internal disturbances in the crystal corresponding to the Einstein functions. It would be wrong to identify them with incoherent vibrations of the individual atoms or molecules in the lattice. Indeed, in a perfect crystal, the correct way to picture them would be to regard them as a vibration of the inter-penetrating lattices forming the crystal as rigid wholes relatively to each other, so that the phase of such vibration is the same everywhere throughout the crystal.

Since the structure-amplitude corresponding to any particular spacing in the crystal depends on the positions of the atoms in the unit cell of the lattice, it is clear that a periodic vibration of the inter-penetrating lattices would cause a corresponding variation with time of each structure-amplitude. If, therefore, the crystal is traversed by a beam of monochromatic X-rays, the Bragg reflections (where these are possible) would also be affected by the periodic variation of structure-amplitude. Viewed in a classical way, this would mean that the intensity of the Bragg reflection, instead of being constant with time, would be modulated by the infra-red frequency. In other words, if the X-ray reflections could be analysed by a spectroscope of sufficiently high resolving power, we would find three components, one having the original frequency of the incident monochromatic X-radiation, and the other two, a frequency greater and less respectively than this frequency by that of the internal vibration in the crystal.

The foregoing classical view-point, though it serves to indicate the possibility of X-ray reflections with altered frequency, is fundamentally inadequate. As in the case of the scattering of light with change of frequency, it fails to tell us exactly what we do observe. For instance, on the classical theory, reflections with relatively large changes of frequency could not occur, as the corresponding lattice vibrations would not be thermally excited to any appreciable extent. On the principles of the quantum theory, however, the position would be different; the lattice-vibration, even when of high frequency and therefore not initially present, would be excited by the incidence of the X-ray itself. The intensity of the reflection with change of frequency would in fact depend on the change of structure-amplitude as indicated by the classical considerations, but the law of temperature variation would be altogether different.

The quantum view-point also indicates that we may expect to be able to observe the modified reflections independently of the unmodified ones, instead of merely accompanying them as is indicated by the classical considerations. To appreciate why this is the case, we have only to recall that the reflection of the usual type cannot occur if the spacing in the crystal, the angle of incidence and the wave-length of the incident monochromatic X-rays do not satisfy the Bragg formula. The modified X-ray reflections are, however, not determined by the fixed positions of the atoms in the crystal, but by their displacements from the same. By a suitable adjustment of the phases of these displacements, the planes of constant phase may be inclined at an angle to the crystal spacings in such manner as to satisfy the Bragg relation for the modified reflections. In other words, we would get a modified reflection from a given set of crystal planes even if when an unmodified one is not possible with the given X-ray wave-length.

Modified X-ray reflections of the kind discussed above are to be seen in Fig. 1 which is a Laue photograph obtained with a crystal of diamond, the X-rays being from a tube with copper target excited at 41,000 volts. The crystal plate which had its faces parallel to one of the octahedral cleavages of diamond was so set that the incident X-ray beam was nearly normal to the crystal faces. The white radiation present gives the usual Laue spots, the pattern exhibiting approximate trigonal symmetry. The three most intense spots in the pattern (marked A, B, C in the figure) are the reflections from the [111] planes parallel to the three other octahedral cleavages of the diamond. It will be noticed that these spots are accompanied by companions which lie on the radial lines joining them with the centre of the pattern, the positions and intensities of the companions being however different. Spot A has two faint companions lying outside. Spot B has also two companions lying one on either side of it, while spot C coincides with the inner one of its own companions. These companions are the modified reflections of the Cu K_α and Cu K_β radiations, and the spacing of the planes responsible for them is the same as that of the [111] planes in the crystal, though of course, their inclination to the incident beam is different, as explained above. The striking variation in the intensity of the spots is evident in the picture and is clearly related to their position relatively to the [111] Laue reflections. In fact, the intensity of the modified reflection is seen to fall off rapidly with the increasing inclination of the phase-waves to the [111] spacings.

The case of the diamond is of exceptional interest, both because of the fact that it approaches closely to an ideal crystal, and also because of the simplicity of its crystal

structure which consists of two similar interpenetrating lattices. The frequency of the vibration of these two lattices relatively to each other is known from studies on light-scattering in diamond to have the high value of 1332 cm.$^{-1}$ in spectroscopic units or in absolute measure, 40×10^{12} per second. It will be seen on examining a crystal model of diamond that an oscillation of the two lattices relatively to each other would cause a large variation of the structure-amplitude of the crystal for the [111] spacings. The frequency of the vibration is so high that at the ordinary temperature its thermal excitation is negligible. The fact that the modified reflections are as intense as they are is thus explicable only on the quantum point of view.

In addition to the modified reflections, Fig. 1 shows other features of great interest, *e.g.*, a diffuse halo falling off in intensity as the [111] reflections are approached and faint streamers stretching out obliquely from the modified reflections. Into the explanation of these features, we shall not here enter.

THE SEVERE MAGNETIC STORM OF MARCH 24, 1940

BY

M. R. RANGASWAMI AND N. C. BASU

(Colaba Observatory, Bombay)

A VERY violent magnetic storm was recorded by the magnetographs at the Alibag Observatory from $13^h\ 50^m$ G.M.T., on March 24, 1940. The duration of the storm was about 27 hours. In point of intensity, this appears to be the severest of all the storms recorded during the last 70 years. The only storms that approach the present one in severity are those of 13th May 1921, 7th July 1928, and 16th April 1938. In Fig. 1 are reproduced the Horizontal force and Declination magnetograms of the severe storm of March 24, 1940, as recorded by the Alibag instruments. The vertical force trace is unfortunately very faint and cannot be reproduced satisfactorily.

During the course of this storm considerable dislocation of telegraph traffic was observed by the Indian Telegraph Department in all their circuits. According to Reuter's news report, similar disturbance to telegraphic transmission was experienced all over the world. The storm played havoc with radio and cable communications in England. In New Zealand, the radio station could not re-broadcast the news broadcast from Britain. The most intense period of the storm as seen from the Alibag records was between $15^h\ 45^m$ and $19^h\ 3^m$ on the 24th March and the Reuter's report says that the United States suffered most severely during this period of the storm and that communications with Europe and South America were crippled for about five hours. The telephone and teleprinter circuits were also put out of action. Britain's overseas radio and cable communications were severely interrupted.

A few days prior to the severe storm there was a gorgeous display of Aurora Borealis as far south as Bulgaria and also at Bologna in Italy. Aurora Australis is reported to have been observed in the southern hemisphere. No unusual activity on the sun was, however, noticed till March 24, the day of the severe storm, when seven large spots were reported to have been seen on the sun at the Heyden Planetarium, United States.

The Solar Physics Observatory at Kodaikanal, on the other hand, observed a large sun-spot group approaching the central meridian on the morning of March 25, when the storm was still in progress. No other special solar activity was noticed at Kodaikanal but the surrounding flocculus showed some bright points.

An examination of the magnetograms shows that practically quiet conditions prevailed from $20{\cdot}5^h$ on March 20 to 6 hours on March 23. At $6^h\ 17^m$ on the 23rd, however, a moderate disturbance began with a marked "sudden commencement" and continued till $13^h\ 50^m$ on March 24, when the violent storm commenced.

CHARACTERISTICS OF THE STORM

The storm began at $13^h\ 50^m$ G.M.T., on March 24, 1940, with a sudden increase of 62 gammas in H, a change of $1{\cdot}3'$ westerly in D and a fall of 10 gammas in Z. $15^h\ 45^m$ on March 24, marked the beginning of the most violent period of the storm. At

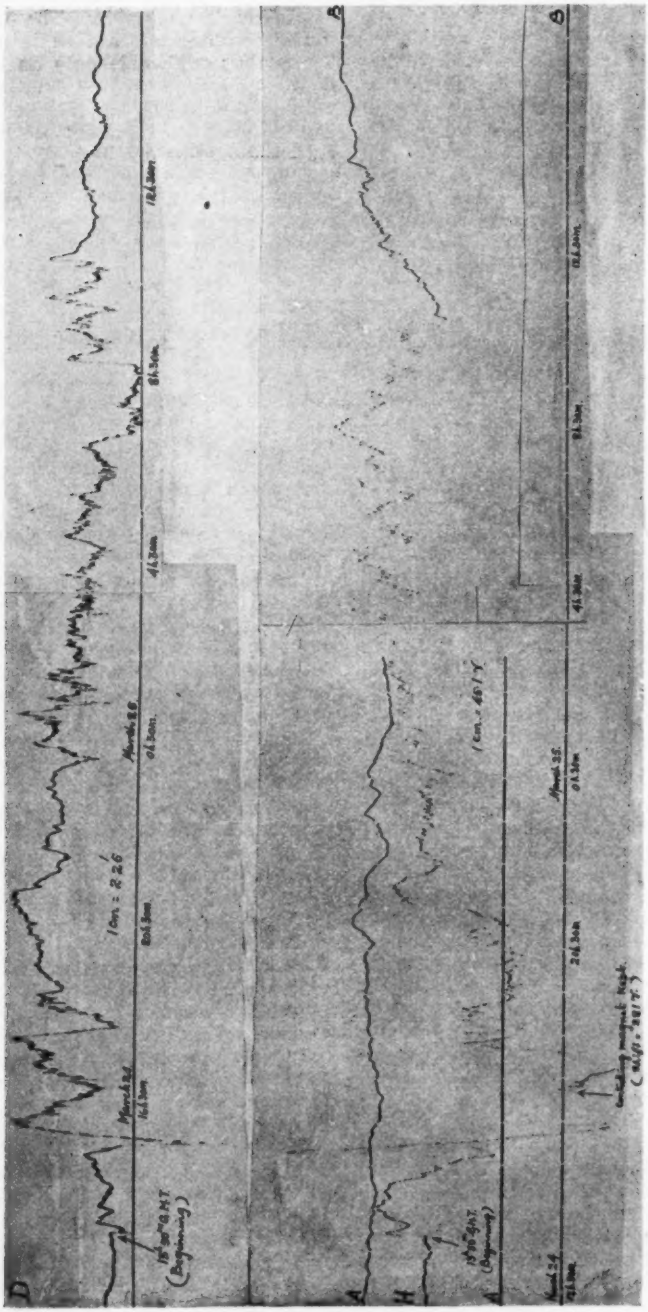


FIG. 1
The Severe Magnetic Storm of March 24, 1940, recorded at Alibag

this time, H and westerly D rose suddenly by 321 gammas and 8·3′ respectively. The sudden rise of 321 gammas in H is so far the largest value of any instantaneous rise in H recorded at Alibag. Reaching its maximum value at $15^h\ 46^m$ H experienced a very sudden fall of 500 gammas in 36 minutes. At $16^h\ 33^m$ it fell so rapidly that it immediately went off the recording limit of the photogram causing a loss of record between $16^h\ 33^m$ and $17^h\ 8^m$. Later on H was brought within the field by the use of a controlling magnet which shifted the trace by 281 gammas. After 32 minutes H fell further and the light speck was off the recording sheet again from $17^h\ 40^m$ to $18^h\ 4^m$, in spite of the controlling magnet. During this interval H attained its minimum. Though the actual value of the range cannot be determined due to the loss of the minimum outside the magnetogram, it is believed to exceed 785 gammas by a fair amount. The H range in this storm is the highest so far recorded at Alibag. The ranges in D and Z were 17 minutes and >100 gammas respectively but these limits have been exceeded on some previous occasions. Pronounced oscillations in H continued between $18^h\ 18^m$ and $19^h\ 18^m$, when they became feebler. At $21^h\ 4^m$, H rose with fluctuations till $21^h\ 56^m$ when it fell. Minor fluctuations continued till $0^h\ 3^m$ on March 25, when disturbed conditions reappeared and continued till $11^h\ 6^m$ after which a gradual return to pre-stormy conditions commenced. The storm ended at about $18·5^h$ on March 25, 1940.

PALÆOBOTANY IN INDIA

THE study of palæobotany in India on modern lines may be said to have begun in the year 1921 when Prof. Birbal Sahni, on his return to India after a distinguished career at Cambridge, started the Lucknow School of Palæobotanical Research. Due to his unbounded enthusiasm and under his able direction the study of palæobotany soon made rapid strides, with the result that during these 20 years not only has an enormous amount of valuable palæobotanical work been done by himself and his coworkers at Lucknow, but our interest in the study of fossil plants has been so successfully revived and stimulated that quite a number of other centres of palæobotanical research have come into existence in different parts of the country; and the total number of papers published year after year is rapidly on the increase. There has thus arisen the need for a suitable body to co-ordinate these activities, and we are glad to find that Prof. Sahni himself has taken the lead in the matter and has arranged to publish hereafter annual reports of the progress of palæobotanical studies in India; and in this task, he will be assisted by a committee composed of all the important workers in this field in India.

From a perusal of the first number of the Progress Report which is now before us, we are struck by the large number and variety of palæobotanical investigations now being pursued in India. As is only naturally expected, a large portion of this work is being done by Prof. Sahni himself and his coworkers at Lucknow—Miss C. Virkki, R. V. Sitholey, K. Jacob, A. R. Rao and others—resulting in most valuable contributions to our knowledge of fossil floras in India, the importance of which has secured world-wide recognition.

The discovery in 1931 by Prof. L. Rama Rao (Bangalore) of fossil algæ in the Cretaceous rocks of South India revealed a new field of palæobotanical research in India, and from the Report now under review, it is seen that Prof. Rama Rao and his co-workers S. R. Narayana Rao and K. Sripada Rao have been making extensive and valuable contributions in this field. The rich algal flora which they have recently discovered in the Eocene beds of the Salt Range has provided a new wealth of material for study of great interest both from the stratigraphical and palæobotanical points of view.

A valuable collection of fossil plants from the Pleistocene Karewas of Kashmir recently made by de Terra, is being described by Mr. G. S. Puri (Amritsar). Over 90 species belonging to 48 genera and 24 families have already been determined, nearly all of them being similar to modern forms living in parts of Kashmir.

We welcome the Report as a most valuable publication and we have no doubt that under the inspiring leadership of Prof. Sahni, the study of palæobotany has a great future in this country.

Prof. K. S. KRISHNAN, D.Sc., F.R.S.

KARIAMANIKKAM SRINIVASA KRISHNAN who has recently been elected by the Royal Society of London to its Fellowship was born at Watrap in South India on the 4th of December 1898. His early education was at the Hindu High School, Srivilliputtur and the American College, Madura. Later, he was at the Christian College, Madras and the University College of Science, Calcutta. He started his career as a demonstrator in chemistry at the Christian College, Madras, but did not continue long in this comparatively unproductive occupation. His search for a suitable place which offered sufficient scope for research work led him to the *Indian Association for the Cultivation of Science at Calcutta* where he came into contact with Prof. Raman. The latter was then leading an active school of research at Calcutta, and Krishnan enlisted himself as a research scholar under his guidance in November 1923. After staying there for a period of about five years, during which time he exhibited an extraordinary capacity for original work in several branches of physics, Krishnan was appointed Reader in Physics at the *Dacca University*. He held this post from the end of 1928 to the middle of 1933. During this period, he initiated independent lines of work and consequently a number of enthusiastic students gathered round him. In 1933, when Prof. Raman had to leave Calcutta to take up his duties at Bangalore, Krishnan was called upon by Prof. Raman who was then the Honorary Secretary of the *Indian Association for the Cultivation of Science*, to take up the newly founded Mahendra Lal Sircar Research Professorship in Physics at the Association. Krishnan accepted the offer and has since then been occupying this chair. His election to the Fellowship of the Royal Society is a well-deserved distinction and constitutes an expected landmark in the career of so distinguished a researcher as Krishnan. This is not only a fitting tribute to the memory of the late Dr. Mahendra Lal Sircar but also speaks volumes for the foresight of Prof. Raman who was responsible for creating the Mahendra Lal Sircar Professorship and inviting Krishnan to accept the same.

Krishnan is the author of numerous original papers dealing with a variety of subjects such as magnetism, optics and crystallography. During the period of his stay as a Research Associate at the *Indian Association for the Cultivation of Science*, he collaborated with Prof. Raman in extensive theoretical and experimental investigations on the scattering of light, molecular optics and particularly in the researches leading to the discovery of the Raman Effect. While at Dacca, he started work on magnecrystallic action and made important contributions dealing with the significance of magnetic anisotropy to crystal structure. His more recent publications include papers dealing with pleochroism and fluorescence in crystals, properties of free electrons in solids, thermo-magnetic behaviour of crystals at low temperatures and other allied topics.

In 1936, he was invited to attend the International Conference on Photoluminescence held at Warsaw. In 1937, he toured in Europe and delivered lectures by invitation at the Cavendish Laboratory in Cambridge, at the Royal Institution in London and at other places. During that year, he was also awarded the Liege University medal. Last year, he again visited Europe as he was invited to participate in a conference on magnetism arranged at Strasbourg by the *International Institute for Intellectual Co-operation* which is one of the organisations of the League of Nations. On this occasion as well, he delivered lectures at various universities in England and in the Continent. He presided over the Physics Section of the twenty-seventh annual meeting of the *Indian Science Congress* held early this year at Madras. As the Mahendra Lal Sircar Professor of Physics at the *Indian Association for the Cultivation of Science*, Calcutta, Krishnan guides with conspicuous success the activities of a productive school of research.

S. BHAGAVANTAM.

LETTERS TO THE EDITOR

	Page
Equilibrium between H_2O and D_2O. By I. Ramakrishna Rao and Y. Paramasiva Rao	171
Structure of λ2916 of OD and the Mass Ratio of the Hydrogen Isotopes. By K. R. Rao and M. G. Sastry	172
Interaction of Atomic Energy Levels—Part III. By T. S. Subbaraya, K. Seshadri and N. A. Narayana Rao	173
Molecular Structure of Some of the Selenium and Tellurium Compounds. By Mata Prasad and S. S. Dharmatti	175
Heterocyclic and Other Derivatives of Sulphanilamide. By B. K. Nandi and K. Ganapathi	177
Synthesis of Anti-Malarial Drugs in Acridine Series. By B. K. Nandi	177
Pongamol, A New Crystalline Compound from Pongamia Oil. By S. Rangaswami and T. R. Seshadri	179
A New Disease of Wheat in India. By G. Watts Padwick	179
A Note on the Development of the Embryosac in Vogelia indica *(Lamk.).* By Kanhaiya Lal Mathur	180
Vascular Anatomy of the Pistillate Flower of Enalus acoroides *(L. fil.), Steud.* By S. B. Kausik	182
Some Chemical and Physical Properties of Water Caltrop Starch. By J. L. Sarin and R. L. Sehgal	185
On the Inter-dependence of Transpiration Rates of Leaves on a Plant. By R. D. Asana	186
"Ascu" Wood Preservative. By L. Mason	187
A National Research Council for India. By K. L. Moudgill; M. R. Siddiqi	188
The Rights of Man. By Gilbert J. Fowler	189

Equilibrium between H_2O and D_2O

With a sample containing 99·4 per cent. D_2O, we investigated the changes in the structure of the Raman bands of H_2O and D_2O, when the liquids were mixed. A comparison of the pure H_2O and D_2O bands with those for the mixture, revealed a profound influence of each liquid on the other. A study of the distribution of intensity in the bands corresponding to each compound, indicated clearly the following results.

While the Raman band for pure H_2O, with its maximum at 3443 extended from 2977–3817 with two inflections at 3229 and 3632, the same band for the mixture became narrower, the extent being reduced to 3080–3808. There is a slight shift in the central maximum from 3443 for the pure compound to 3461 for the mixture. More conspicuous is the change in the distribution of intensity on the lower frequency side of the band. While for pure water, the band had a definite convexity, in the mixture, this changed to a concavity, thus revealing a diminution in the intensity of this portion of the band.

The changes in the structure of the D_2O band were still more prominent. In the pure state, this liquid gives rise to a band extending from 2194 to 2844, with two clear maxima at 2538 and 2400. In the mixture, however, the second maximum entirely disappears, leaving the other with a slight shift to 2523. The width of the band also diminishes to 2244–2810.

To compare the relative intensities of the bands in the pure state with those in the mixture, the Raman spectra of the pure liquids and those of the mixture were taken on the same plate, the time of exposure for the mixture being double that for the pure liquids. If, on mixing, there were no changes in the structure of the liquids, the intensity distribution of the bands in the mixture should be the same as for the pure liquids. But actually, there was a decided change.

For pure water, the intensity of the maximum at 3443 showed a slight increase. But the maximum of the D_2O band at 2538 increased in intensity by nearly 50 per cent.

These changes are similar to those of change of state or of temperature, and are explicable on the basis of the change in the polymerisation of these liquids. The diminution of the intensity of the H_2O band on the lower frequency side in the mixture indicates the depolymerisation of the $(H_2O)_3$ molecules to which this portion of the band is supposed to

correspond. This change in the structure of the H_2O band lends support to the view that the $(H_2O)_3$ molecules are less stable than the other polymers as postulated by one of us.[1]

A similar explanation applies to the changes in the structure of the D_2O band. The disappearance, in the band for the mixture, of the maximum at 2400 supposed to correspond to $(D_2O)_3$ molecules, is due to the instability of this polymer as compared to $(D_2O)_2$ and D_2O.

In addition to the above changes, there is another possibility, *viz.*, that of the formation of HDO. The frequencies of this compound as calculated by Van Vleck and Cross[2] are 1400, 2720 and 3750 and the experimental value for the vapour reported by Rank, Larson and Bordner[3] is 2718. The latter found no trace of any lines corresponding to 3750 and 1400 for HDO. The above result seems to be confirmed by our work also. While there is a considerable increase in the intensity of the D_2O band from the pure state to the mixture, the corresponding H_2O band increases only slightly in intensity.

As required by the law of mass action, the proportion of HDO molecules formed in a 50 : 50 mixture of H_2O and D_2O studied by us should be 48·6 per cent. while H_2O and D_2O are each 25·7 per cent., if the equilibrium constant is assumed to be 3·28 as given by Urey and Rittenberg.[4] The abnormal increase in the intensity of the D_2O band must be due to the superposition of the HDO band over it (Wood[5] gives the frequency of this band for the liquid state as 2623 $cm.^{-1}$), while in the case of the H_2O band, the slight increase in intensity is due only to the splitting up of the higher polymers of water into the lower, which thus increase the number of the double molecules giving rise to the maximum at the centre of the H_2O band, there being no contribution to this increase by the O-H oscillation of the HDO molecules as no band due to this oscillation was detected by Rank, Larson and Bordner.

Thus while there are two factors, *viz.*, increase in double molecules of D_2O and superposition of the HDO band which increase the intensity of the band in the case of D_2O, counterbalancing the diminution in the number of the D_2O molecules on account of conversion into HDO molecules, there is only one factor which tends to increase the intensity of the water band, *viz.*, the increased number of $(H_2O)_2$ molecules, due to the depolymerisation of the $(H_2O)_3$ molecules, which are just more than counterbalancing their diminution due to conversion into HDO molecules.

I. Ramakrishna Rao.
Y. Paramasiva Rao.

Andhra University,
Waltair,
March 14, 1940.

[1] I. R. Rao, *Proc. Roy. Soc.*, 1934, **145 A**, 489.
[2] Van Vleck and Cross, *J. Chem. Phys.*, 1933, **1**, 357.
[3] Rank, Larson and Bordner, *ibid.*, 1934, **2**, 464.
[4] Urey and Rittenberg, *ibid.*, 1933, **1**, 137.
[5] R. W. Wood, *Phys. Rev.*, 1934, **45**, 392.

Structure of λ 2916 of OD and the Mass Ratio of the Hydrogen Isotopes

In the course of a general investigation on the emission bands of heavy water, the authors have photographed discharges through vapour of pure heavy water and obtained the electronic band system $^2\Sigma^+ \rightarrow {}^2\pi_{1/2}$ of the OD molecule in the region $\lambda 3600 - \lambda 2400$, perfectly free from any trace of the bands of the OH molecule. Measurement of the bands have led to the elucidation of the rotational structure of the (1, 0) and (2, 1) bands at $\lambda 2872$ and $\lambda 2916$ and to the evaluation of the associated constants of the OD molecule. The values determined for the band at $\lambda 2872$ have been communicated to *Nature*. The constants for the band at $\lambda 2916$ are (in $cm.^{-1}$),

$B_2' = 8{\cdot}317$ $\quad D_2' = -{\cdot}597 \times 10^{-3}$
$B_1'' = 9{\cdot}544$ $\quad D_1'' = -{\cdot}413 \times 10^{-3}$

The wave numbers of the lines $R_1(1)$ and $Q_1(1)$ are 34273·4 and 34238·1 $cm.^{-1}$ respectively.

Supplementing the data on these bands, with those published by Ishaq[1] it has been possible to determine the vibrational energy intervals

for the upper $^2\Sigma^+$ state. These are $\Delta\nu'_{\frac{1}{2}} = 2214{\cdot}6$; $\Delta\nu'_{1\frac{1}{2}} = 2110{\cdot}6$; $\Delta\nu'_{2\frac{1}{2}} = 2009{\cdot}2$. The value of ω_e deduced from these, gives the mass ratio of the hydrogen isotopes

$$\rho = \frac{\omega_e'\,(\mathrm{OD})}{\omega_e'\,(\mathrm{OH})} = 0{\cdot}7282$$

which agrees well with the value 0·7281 calculated directly from the isotopic masses $H^1 = 1{\cdot}0081$ and $H^2 = 2{\cdot}0142$.

Full details will be published elsewhere.

K. R. Rao.
M. G. Sastry.

Andhra University,
Waltair,
March 21, 1940.

---

[1] *Proc. Roy. Soc.*, 1937, **159A**, 110; *Proc. Nat. Inst. Sci. India*, 1937, **3**, 389.

Interaction of Atomic Energy Levels
Part III

In continuation of the work previously described in this *Journal*,[1] we have investigated a mixture of cadmium and zinc and compared the relative intensities of various lines in the spectra of the individual metals and in that of their mixture. The method employed to obtain the spectra was the same as before, *viz.*, a discharge from a 2,000 volt 3 KVA transformer sent through a tube containing the metals in side limbs and kept continuously evacuated by a Hyvac Pump. The following changes in relative intensity were observed: square brackets indicate that the change in intensity was small.

Zinc Lines

Strengthened	*Weakened*
3076 (4^1S_0—4^3P_1)	[6362 (4^1P_1—4^1D_2)]
[2558 (Zn II)]	4810 (4^3P_2—5^3S_1)
	4722 (4^3P_1—5^3S_1)
	4680 (4^3P_0—5^3S_1)
	4630 (4^1P_1—5^1D_2)
	[3072 (4^3P_2—6^3S_1)]
	[3035 (4^3P_1—6^3S_1)]
	[3018 (4^3P_0—6^3S_1)]
	[2800 (4^3P_2—5^3D_3)]
	[2770 (4^3P_1—5^3D_2)]
	[2756 (4^3P_0—5^3D_1)]
	[2712 (4^3P_2—7^3S_1)]
	[2684 (4^3P_1—7^3S_1)]
	[2670 (4^3P_0—7^3S_1)]
	[2609 (4^3P_2—6^3D_3)]
	[2583 (4^3P_1—6^3D_2)]
	[2570 (4^3P_0—6^3D_1)]
	[2516 (4^3P_2—7^3D_3)]
	[2492 (4^3P_1—7^3D_2)]
	2480 (4^3P_0—7^3D_1)
	2464 (4^3P_2—8^3D_3)
	[2139 (4^1S_0—4^1P_1)]

Cadmium Lines

Strengthened	*Weakened*
6438 (5^1P_1—5^1D_2)	[5086 (5^3P_2—6^3S_1)]
6330 (5^1P_1—5^3D_1)	4800 (5^3P_1—6^3S_1)
6325 (5^1P_1—5^3D_2)	4678 (5^3P_0—6^3S_1)
[3252 (5^3P_2—7^3S_1)]	4663 (5^1P_1—6^1D_2)
[3133 (5^3P_1—7^3S_1)]	4413 (5^3P_1—6^1S_0)
[3081 (5^3P_0—7^3S_1)]	
[2868 (5^3P_2—8^3S_1)]	
2775 (5^3P_1—8^3S_1)	
2764 (5^3P_2—$7^3D_{2,3}$)	
2734 (5^3P_0—8^3S_1)	
[2677 (5^3P_1—7^3D_2)]	
[2660 (5^3P_2—8^3D_3)]	
[2640 (5^3P_0—7^3D_1)]	
2288 (5^1S_0—5^1P_1)	
2265 (Cd II)	

Discussion.—Taking first the lines that are strengthened, the increase in intensity of 3076 of Zn (upper level has an energy = 32501·6 cm.$^{-1}$) must be due to impacts of the second kind with metastable Cd atoms in the 5^3P_2 state (of energy 31827·3 cm.$^{-1}$). 6438, 6330 and 6325 of Cd have upper levels of energy 59219·6, 59486·4 and 59498·1 cm.$^{-1}$ respectively. The nearest energy levels in zinc are $5^3P_{0,1,2}$ of energy 61247·4, 61274·1 and 61330·3 cm.$^{-1}$ respectively, but lines having these as upper levels are outside the region of our observations so that confirmatory evidence for the interaction of these two sets of levels cannot be adduced. The strengthening of 2764, 2677 and 2640 (energy of upper states is 67997·5, 67992·5 and 67988·9 cm.$^{-1}$) and the weakening of 2800, 2770, 2756 of Zn (upper

FIG. 1

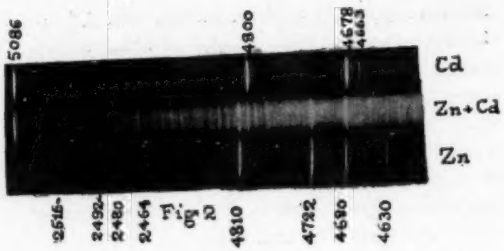


FIG. 2

FIG. 3

FIG. 4

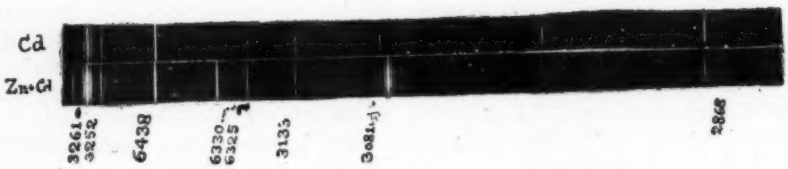


FIG. 5

FIG. 6

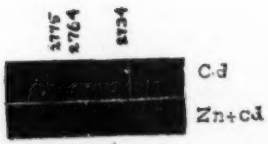


FIG. 7

levels are 68582·9, 68580·9 and 68579·8 cm.$^{-1}$) and of 2712, 2684 and 2670 (upper level = 69746·3 cm.$^{-1}$) points to interaction between these groups of levels. 4630 of Zn (upper level 68337·9 cm.$^{-1}$) has become weaker. Its excitation energy seems to have been taken up by 2734, 2775 and 2868 (upper level = 66681·5 cm.$^{-1}$). which have become strengthened. This latter level may also have been enriched at the expense of 3072, 3035 and 3018 (upper level = 65432·4 cm.$^{-1}$), which are slightly weakened. The slight weakening of Zn 6362 (upper level = 62458·6 cm.$^{-1}$) may be correlated with the slight brightening of 3252, 3133 and 3081 (upper level = 62563·2). The brightening of Cd 2288 (upper level = 43692·2 cm.$^{-1}$) must be brought about by 4^1P_1 of zinc of energy 46745·1 cm.$^{-1}$ and the weakening of 2139 of Zn confirms this. 2139, however, does not affect our film sufficiently to show up clearly and hence it cannot be seen in the reproduction. The strengthening of Cd 2660 (upper level = 69404·3 cm.$^{-1}$) is possibly connected with the weakening of the zinc lines 2609, 2583 and 2570 (upper level = 71213·5 cm.$^{-1}$). 2516, 2492 and 2480 (upper level = 72628·1 cm.$^{-1}$) and 2464 (upper level = 73471·3 cm.$^{-1}$) of Zn, all of which are weakened, have excitation energies very near the ionization energy of cadmium which is 72538·8 cm.$^{-1}$. The slight increase in brightness of the spark line 2265 of Cd may be due to the ionization thus produced. The simultaneous weakening of Zn 4810, 4722, 4680 (upper level = 53672·4 cm.$^{-1}$) and of Cd 5086, 4800, 4678 (upper level = 51484·1 cm.$^{-1}$) is difficult to explain except by assuming that the energy of the first group is given to ionised Cd and that of the second to ionised Zn. Since the spark lines of Zn and Cd are very weak, support for this view is difficult to obtain from their behaviour. The weakening of 4663 (upper level = 65133·9) of Cd will have to be explained in a similar way by assuming that its energy is used to strengthen some spark line, probably 2265 of Cd, but this explanation is only tentative.

In conclusion we have great pleasure in expressing our thanks to Prof. A. Venkat Rao Telang for the many facilities given to us.

T. S. Subbaraya.
K. Seshadri.
N. A. Narayana Rao.

Central College,
Bangalore,
April 12, 1940.

---

[1] *Curr. Sci.*, 1939, **8**, 508; 1940, **9**, 14.

Molecular Structure of Some of the Selenium and Tellurium Compounds

Pauling,[1] Van Vleck,[2] Slater[3] and Angus[4] have shown that the diamagnetic susceptibility of an ion is given by $\chi_A = -\frac{e^2z}{6mc^2}\sum r^2$, where $\sum r^2$ depends upon the valency state of the ion. The validity of this expression has been verified by Farquharson,[5] Gray and Cruickshank,[6] Clow[7] and Bhatnagar and co-workers.[8]

Varadachari and Subramaniam[9] and Nevgi[10] have determined the susceptibilities of a number of sulphur compounds and using Kido's values for the ionic susceptibility of sulphur in different valency states, have assigned suitable valencies to sulphur in these compounds. We have measured the magnetic susceptibilities of about a dozen compounds of selenium and tellurium by the modified form of Gouy's Balance and have calculated the theoretical values of selenium and tellurium in different valency states using Slater's and Angus's methods for the calculation of $\sum r^2$. The calculated and observed values for some of these compounds are shown in Table I.

Incidentally we have calculated the values of $\sum r^2$ according to Slater's and Angus's methods and hence the ionic susceptibilities, for sulphur in different valency states and have used them to calculate the susceptibilities of the sulphur compounds studied by Varadachari and Subramaniam and Nevgi. Table I shows that the values thus calculated for S_2Cl_2 and SO_2Cl_2 agree closely with those experimentally found by Varadachari and Subramaniam and Nevgi, respectively.

TABLE I

Compound	Correct constitution	$-\chi_a \times 10^6$ & $-\chi_m \times 10^6$ observed by the authors	$-\chi_a \times 10^6$ & $-\chi_m \times 10^6$ calculated by Slater's method	$-\chi_a \times 10^6$ & $-\chi_m \times 10^6$ calculated by Angus's method
Se_2Br_2 ..	Br–Se–Se–Br	(χ_a) 0·3544	0·3479	0·3400
		(χ_m) 112·6	110·72	108·18
H_2SeO_3 ..		(χ_a) 0·3515	0·3470	0·3465
		(χ_m) 45·41	44·84	44·77
H_2TeO_3 ..		(χ_a) 0·1966	0·1978	0·1972
		(χ_m) 34·89	35·12	35·00
$(CH_3)_2TeI_2$ ..		(χ_a) 0·3535	0·3547	0·3542
		(χ_m) 145·40	145·85	145·71
S_2Cl_2 ..		(χ_a) 0·461 [9]	0·4613	0·4523
		(χ_m) 62·2 [9]	62·272	61·05
		(χ_a) 0·405 [10]		
		(χ_m) 54·7 [10]		
SO_2Cl_2 ..		(χ_a) 0·365 [9]	0·3891	0·3884
		(χ_m) 49·3 [9]	52·517	52·422
		(χ_a) 0·397 [10]		
		(χ_m) 53·6 [10]		
		(χ_a) 0·402 (Kido)		
		(χ_m) 54·6 (Kido)		

A full account of the work is being sent for publication elsewhere. Authors are thankful to Dr. S. S. Bhatnagar for suggestion and criticisms.

MATA PRASAD.
S. S. DHARMATTI.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
April 2, 1940.

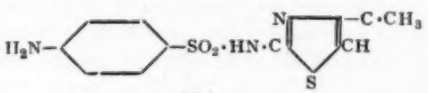
[1] Pauling, *P. R. S.*, 1927, **114** A, 181.
[2] Van Vleck, *Phys. Rev.*, 1928, **31**, 587.
[3] Slater, *ibid.*, 1930, **36**, 57.
[4] Angus, *P. R. S.*, 1932, **136** A, 569.
[5] Farquharson, *Phil. Mag.*, 1932, **14**, 1003.
[6] Gray and Cruickshank, *Trans. Farad. Soc.*, 1935, **32**, 1491.
[7] Clow, *ibid.*, 1937, **33**, 381.
[8] Bhatnagar, *Curr. Sci.*, 1935, **4**, 153, 234; *J. Ind. Chem. Soc.*, 1935, **12**, 799; *J. C. S.*, 1936, **13**, 278; *ibid.*, 1938, 1428; *Proc. Ind. Acad. Sci.*, 1939, **10**, 150.
[9] Varadachari and Subramaniam, *Proc. Ind. Acad. Sci.*, 1936, **2A**, 428.
[10] Nevgi, *J. Univ. Bombay*, 1938, **7**, 82.

Heterocyclic and Other Derivatives of Sulphanilamide

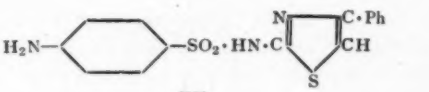
In continuation of our note,[1] a few other heterocyclic derivatives of sulphanilamide have been prepared. 2-Amino-4-methyl thiazole and 2-amino-4-phenyl thiazole have been condensed with para-acetamino benzene sulphochloride in acetone and pyridine and the products after hydrolysis with sodium hydroxide or hydrochloric acid, yielded respectively 2-N′-sulphanilamido-methyl thiazole (I) and 2-N′-sulphanilamido-phenyl thiazole (II).

Also 2-amino-anthraquinone has been condensed with para-acetamino benzene sulphochloride in a similar way and hydrolysis yielded 2-N′-sulphanilamido anthraquinone (III).

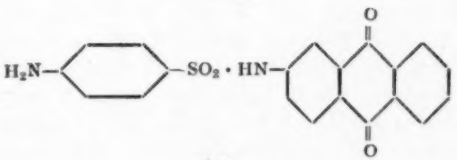
Amino-thiodiazines are also being condensed with para-acetamino benzene sulphochloride. One compound 2-N′-sulphanilamido 5-hydroxy-1 : 3 : 4-thiodiazine (IV) has been obtained by condensing 2-amino-5-hydroxy-1 : 3 : 4-thiodiazine[2] with para-acetamino benzene sulphochloride and subsequent hydrolysis.



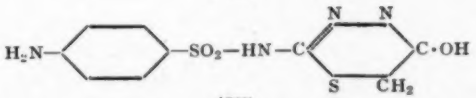
(I)



(II)



(III)



(IV)

Attempts are also being made to condense substituted thiodiazines[3,4] with para-acetamino benzene sulpho-chloride.

Detailed experiments and reports of their therapeutic value against bacterial infections will be published elsewhere.

B. K. Nandi.
K. Ganapathi.

Haffkine Institute,
Parel, Bombay,
March 20, 1940.

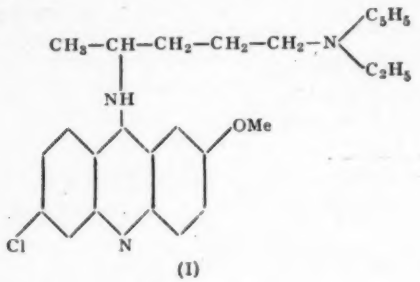
[1] Ganapathi and Nandi, *Curr. Sci.*, 1940, **9**, 67.
[2] Bose and Nandi, *Jour. Ind. Chem. Soc.*, 1933, **7**, 961.
[3] ——, *ibid.*, 1930, **7**, 733.
[4] ——, *ibid.*, 1931, **8**, 311.

Synthesis of Anti-Malarial Drugs in Acridine Series

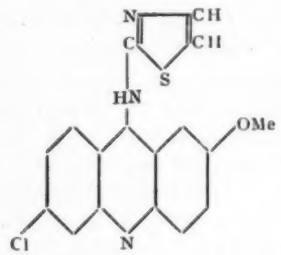
Since the synthesis of the remarkable anti-malarial drug atebrin[1] (I) various side chains have been attached to the acridine nucleus.[2] In all cases, however, the anti-malarial activity has been found to be decidedly inferior to atebrin. So far no heterocyclic or carbocyclic derivatives of 2-methoxy-6 : 9-dichloro acridine[3] seem to have been reported. Some heterocyclic and carbocyclic derivatives of 2-methoxy-6 : 9-dichloro acridine have now been prepared and their anti-malarial property is being studied in monkey malaria in this laboratory.

2-Amino thiazole has been condensed with 2-methoxy-6 : 9-dichloro acridine in phenol medium giving 2-methoxy-6-chloro-9-N-2′-thiazole-amino acridine (II) in good yield. Similarly 2-amino-4-methyl thiazole and 2-amino-4-phenyl thiazole yielded respectively 2-methoxy-6-chloro-9-N-2′-(4′-methyl thiazole)-amino acridine (III) and 2-methoxy-6-chloro-9-N-2′(4′-phenyl thiazole)-amino acridine (IV). Also 2-amino-pyridine and 2-amino anthraquinone gave respectively 2-methoxy-6-chloro-9-N-2′-pyridyl-amino acridine (V) and 2-methoxy-6-chloro-9-N-2′- anthraquinone - amino acridine (VI). In a similar way, 6-methoxy-8-amino quinoline and 2-amino-5-hydroxy-1 : 3 : 4-thiodiazine[4] were condensed in phenol medium respectively giving rise to 2-methoxy-6-chloro-9-N-8′(6- methoxy - quinoline) - amino

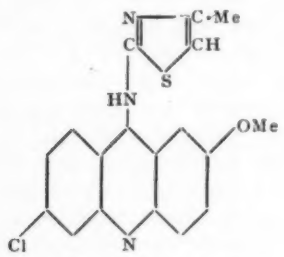
acridine (VII) and 2-methoxy-6-chloro-9-N-2'-(5-hydroxy-1 : 3 : 4-thiodiazine)-amino acridine (VIII).



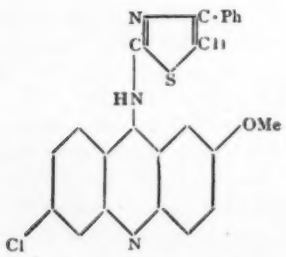
(I)



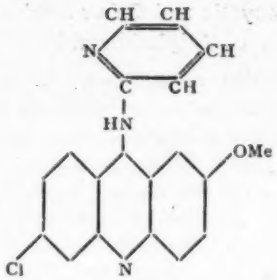
(II)



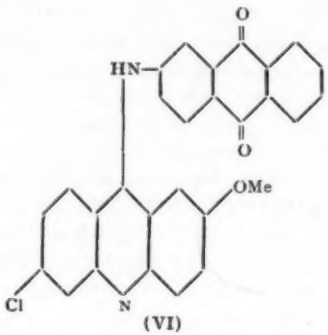
(III)



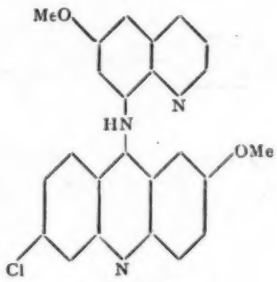
(IV)



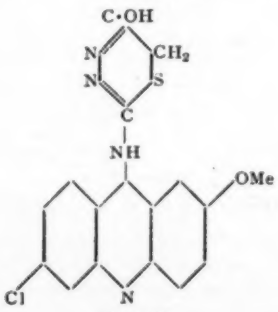
(V)



(VI)



(VII)



(VIII)

The condensation of sulphanilamide with 2-methoxy-6 : 9-dichloro acridine has already been reported.[5] Acridine derivatives of other amino-thiazoles and amino-thiodiazines are being prepared.

The detailed experiments and the results of their action against malaria and bacterial infections will be reported elsewhere.

B. K. NANDI.

Haffkine Institute,
Parel, Bombay,
March 26, 1940.

[1] Mietsch and Mauss, *Klin. wchschr.*, 1933, No. 33, 12760.

[2] Magidson and Grigorowsky, *Ber.*, 1936, **69**, 396.

[3] Magidson *et al*, *Chem. Pharmaz. Ind.* (U.S.S.R.) 1935, No. 1.

[4] Bose and Nandi, *Jour. Ind. Chem. Soc.*, 1930, **7**, 961.

[5] Ganapathi and Nandi, *Curr. Sci.*, 1940, **9**, 67.

Pongamol, A New Crystalline Compound from Pongamia Oil

CRUDE karanjin extracted from the pongamia oil with alcohol[1] gave certain prominent colour reactions which were not produced by the purified compound. With concentrated sulphuric acid it gave a yellow solution which turned emerald green in the course of five minutes and when a drop of ferric chloride was added to an alcoholic solution an intense red colour was produced. This was obviously due to the existence of a second chemical entity to some extent in crude karanjin. The occurrence of this compound in pongamia seed oil and cake was investigated by means of the strong ferric chloride colour. Samples of oil and cake were extracted with alcohol and the alcoholic extracts tested with ferric chloride. Oil obtained by expression or by solvent extraction, fresh as well as old, gave positive tests. The seed cake left after pressing gave positive reaction, but not the one obtained by solvent extraction. The capacity to give the colour test is therefore closely associated with the presence of the oil, whose complete removal is the cause of the negative test with solvent-extracted cake.

The chemical compound responsible for the above bright colour reactions has now been isolated in a crystalline condition and is named "pongamol" indicating its origin and phenolic nature. It crystallises from alcohol in the form of big rhombic prisms and melts at 128–29°. It contains no nitrogen, sulphur and halogen and has the formula $C_{18}H_{14}O_4$. It possesses a methoxyl group, produces a red anthocyanin by reduction with magnesium and hydrochloric acid, gives a derivative with *p*-nitrobenzoyl chloride and yields benzoic acid on oxidation or hydrolytic fission. It therefore seems to belong to the important naturally occurring group of hydroxyflavones.

Details regarding the preparation, properties and constitution of pongamol will soon be published.

S. RANGASWAMI.
T. R. SESHADRI.

Department of Chemistry,
Andhra University,
Waltair,
March 23, 1940.

[1] Subba Rao, Veerabhadra Rao and Seshadri, *Proc. Ind. Acad. Sci.*, 1939, **10A**, 65.

A New Disease of Wheat in India

ON March 7th, 1939, the author visited the Botanical Sub-station of the *Imperial Agricultural Research Institute* at Pusa. It was found that several varieties of wheat were suffering from foot-rot, the symptoms being suggestive of *Fusarium*. One variety, Pusa 12, had different symptoms. The plants were bleached and prematurely ripened and the ears contained only shrivelled grains. The sub-coronal internodes were found to be shiny black, and the roots were black and rotten. The symptoms were suggestive of "take-all".

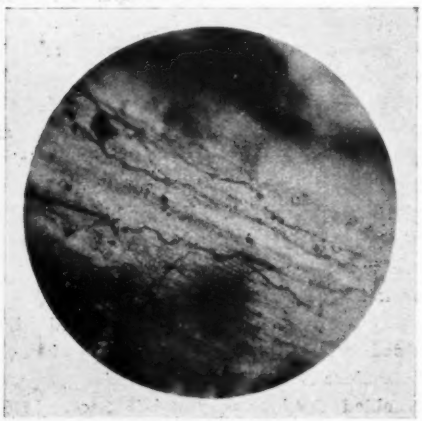
Isolations were made from these plants a month later. Ten pieces of diseased tissue yielded in all seven cultures of *Fusarium* and one culture which in its mycelial characters resembled *Ophiobolus graminis* Sacc. It had the two kinds of hyphæ typical of the fungus,

the fine hyaline septate hyphæ and the composite strands consisting of groups of thick "Macrohyphæ" dark in colour and strongly septate. The culture has so far produced no perithecia and no spores of any kind.

Owing to the hot weather prevalent at the time it was not convenient to make a test of the pathogenicity of the fungus.

In October 1939 twelve 100 c.c. Erlenmeyer flasks, each containing 45 grammes of soil, 5 grammes of maize-meal and 15 c.c. of water were sterilized and inoculated with the fungus. The contents of each flask were used on December 19th to infest sterilized soil in a six-inch flower pot. In each flower pot twenty-five seeds of Pusa 12 wheat were sown. On January 6th, 1940, the inoculated plants showed signs of withering and pallor of the youngest leaves and two days later they were turning distinctly yellow. The plants were much smaller than the control series in which sterilized maize-meal-soil mixture without the fungus had been added.

On removing the infected seedlings from the soil it was found that the bases of the stems were flecked with black and in severe cases were entirely of a black colour and shiny in appearance. The roots were rotten and black in colour, and carried on their surfaces the macro-hyphæ typical of *Ophiobolus graminis* (see photo-micrograph).



Macrohyphæ on the root of an inoculated wheat seedling. (× 123·75)

Whether or not the fungus is *Ophiobolus graminis* Sacc. can only be determined if perithecia are produced. It is certainly, however, a disease hitherto unrecorded in India.

G. Watts Padwick.

Imperial Agricultural Research Institute,
New Delhi,
March 27, 1940.

A Note on the Development of the Embryo-sac in *Vogelia indica* (Lamk.)

The embryology of the Plumbaginaceæ has attracted considerable interest in recent years. Dahlgren[1] published a monograph on the Primulaceæ and Plumbaginaceæ, describing some striking peculiarities in the embryo-sac of *Plumbagella* and other genera of the Plumbaginaceæ. Haupt[2] gave a different account of the development of the embryo-sac in *Plumbago capensis* which was later confirmed by Dahlgren[3] himself. More recently Fagerlind[4] and Boyes[5] have re-investigated *Plumbagella* and in this also the development has been found to be very different from that reported by Dahlgren.

The present work on *Vogelia indica* was started in 1936 at the suggestion of Dr. P. Maheshwari. The plant grows on low-lying rocky hills at Ajmer and Mt. Abu, in Rajputana. The flowers appear in the winter season. The material was fixed in formalin-acetic-alcohol and Nawaschin's fluid and cut at 7–10 microns.

The pistil is closely surrounded by the flattened bases of the staminal filaments and contains a single ovule. When ripe, a long feathery style surmounts the small ovary.

The hypodermal archesporial cell in the nucellus divides into the primary parietal cell and megaspore-mother cell (Fig. 1). By further divisions of the former, two or three layers of wall are formed (Fig. 2). No tetrad of megaspores is produced and the mother cell grows directly into the embryo-sac. The single nucleus divides into two, nuclei and small vacuoles begin to appear even at this stage (Fig. 3). The next division gives rise to four megaspore nuclei which are placed cross-wise as shown in

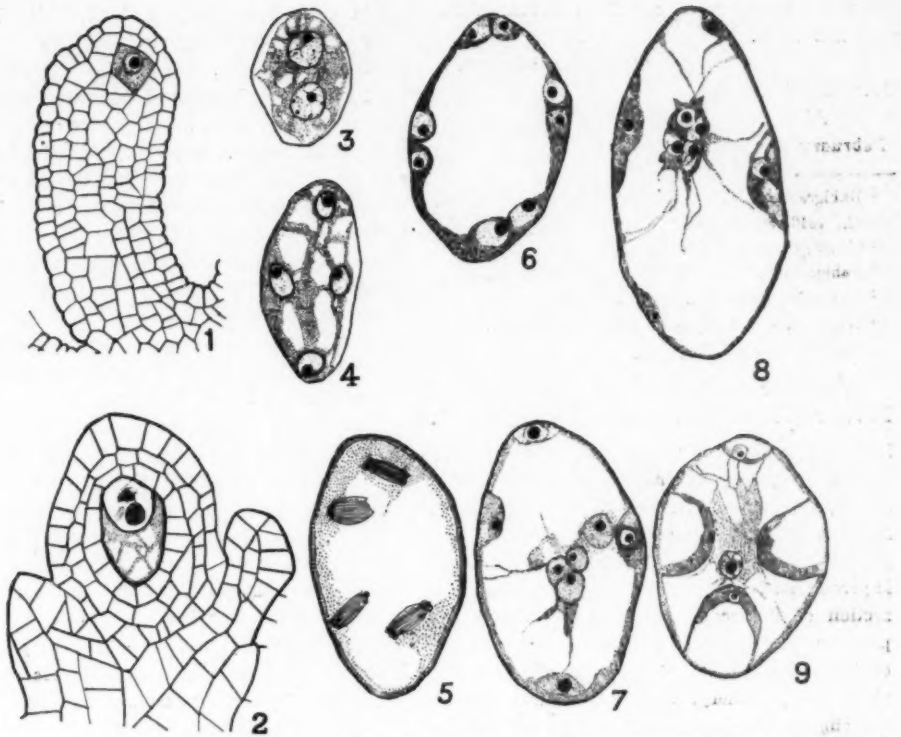


FIG. 1.—L. S. of young ovule, showing primary parietal cell divided anticlinally, and megaspore-mother cell, × 300. FIG. 2.—L. S. of ovule, showing two wall layers and megaspore-mother cell in prophase of reduction division × 400. FIG. 3.—Two-nucleate embryo-sac. × 400. FIG. 4.—Four-nucleate embryo-sac. × 400. FIG. 5.—Four mitoses in embryo-sac, leading to 8-nucleate condition. × 400. FIG. 6.—Eight-nucleate embryo-sac. × 400. FIG. 7.—Embryo-sac showing 4 nuclei meeting to form secondary nucleus. × 300. FIG. 8.—Embryo-sac showing 4 peripheral cells and four polar nuclei fusing in the centre. × 300. FIG. 9.—Mature embryo-sac showing 4 egg-like peripheral cells and secondary nucleus . ×200.

Fig. 4, the vacuolation becoming more prominent now. There is only one further division (Fig. 5), leading to the formation of 8 nuclei which lie in 4 pairs in the peripheral layer of cytoplasm (Fig. 6). The centre, at this stage, is occupied by a vacuole. As shown in Fig. 7, one nucleus from each pair now moves towards the centre and all the four meet to form a large secondary nucleus (Fig. 8). The remaining nucleus of each pair retains its parietal position, and the one towards the micropylar end organises into an egg cell. The other three showed a varied behaviour, which is still under investigation; generally they degenerate, but sometimes they also enlarge like the egg cell and actually become egg-like as evidenced by their structure and vacuolation (Fig. 9).

Such a development of the embryo-sac has so far been recorded only in *Plumbago capensis* (Haupt, 1934) and *Plumbago zeylanica* (Dahlgren, 1937). Further work is in progress and the results will be published very soon in a fuller form.

My slides were kindly examined by Dr. P. Maheshwari of Dacca, who has confirmed these interpretations. The writer is much indebted to

him for suggestions and criticisms in connection with this work.

KANHAIYA LAL MATHUR.

Government College,
Ajmer,
February 15, 1940.

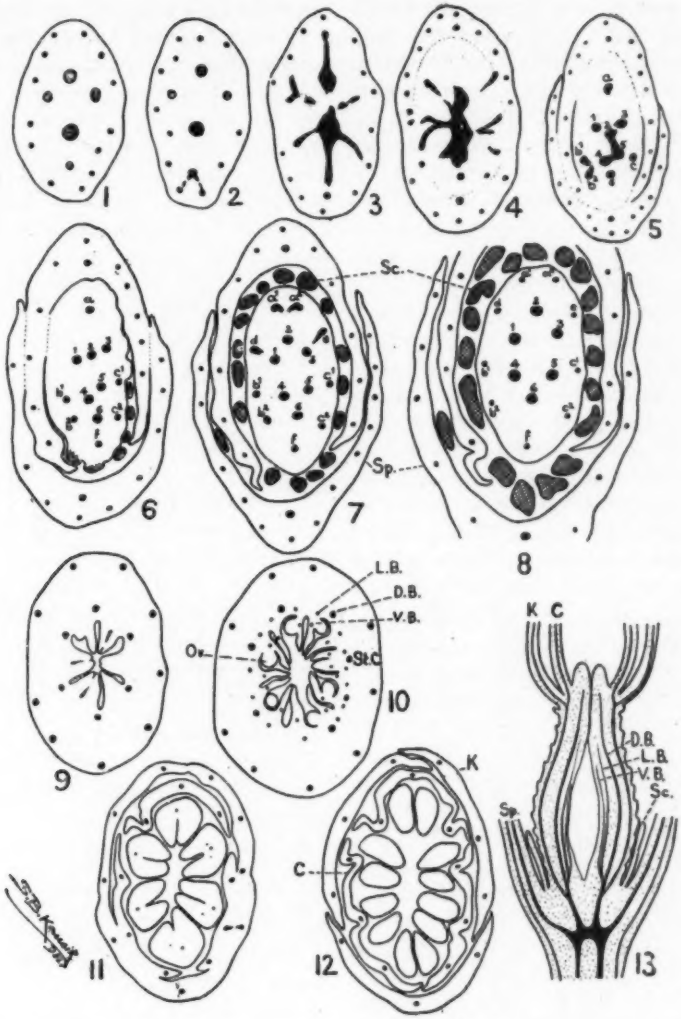
[1] Dahlgren, K. V. O., *K. Svenska Vetensk. Akad. Handl.*, 1916, **56**, (4), 80.
[2] Haupt, *Bot. Gaz.*, 1934, **95**, 649.
[3] Dahlgren, K. V. O., *Botaniska Not.*, 1937, 487.
[4] Fagerlind, *Arkiv. Bot.*, 1938, **29** B, 8.
[5] Boyes, J. W., *Amer. Jour. Bot.*, 1939, **26**, 539.

Vascular Anatomy of the Pistillate Flower of *Enalus acoroides* (L. fil.), Steud.

RECENTLY during the course of a detailed study of the embryology of *Enalus acoroides* (L. fil.), Steud., the writer[1] noticed certain interesting features in the vascular structure of the pistillate flowers and a brief account of these is given now in the present paper. A transverse section of the scape of the flower shows the presence of two large vascular bundles in the centre and a large number of smaller bundles along the periphery. The two central bundles are slightly unequal in size and to this feature has been attributed the coiling of the scape by which the pistillate flower goes under water subsequent to pollination (*cf.* Svedelius[2]). At the base of the flower these two central bundles begin to move towards each other and finally fuse together giving off at the same time a number of branches which move outwards immediately. These branches are next seen arranging themselves in a ring within the original peripheral bundles of the scape. Thus two sets of outer bundles are now formed (Fig. 5) and these two sets enter the two imbricating spathes of the flower (Figs. 5–7). Soon after the departure of these bundles to the spathes the floral vascular tissue shrinks more or less to the centre and gives rise typically to six large bundles (Fig. 5, marked *1–6*), which rapidly undergo a process of readjustment and become regularly arranged (Figs. 6–8). At the same time the six bundles also divide once tangentially and give rise to an outer set of as many, but slightly smaller, bundles (Figs. 5–7). Simultaneously with this three alternating bundles of this outer set divide once radially to form three clearly recognizable pairs (Figs. 5–8, marked *a*, a^1, a^2; *b*, b^1, b^2; and *c*, c^1, c^2). The other three bundles of this set do not divide, but merely move towards the periphery along with the paired bundles. Thus there are now seen at the base of the ovary altogether nine bundles in the periphery and six large bundles forming a circle in the centre (Fig. 8). Both these sets of bundles enter the gynoecium, the outer set of nine pursuing their course further in the wall of the gynoecium, while the inner six form the vascular supplies of the six carpels. Each bundle of the inner set divides at a slightly higher level to form five main bundles, of which the median becomes a large dorsal bundle of the carpel and the others form the two lateral bundles and the two ventral bundles (Figs. 10 and 13).

In the outer set the nine bundles traversing the wall of the gynoecium (Figs. 8, *a–f*) represent the combined sepal-petal traces and the separation into the vascular supplies for the two sets of floral leaves takes place only above the ovary where each of the combined traces divides once tangentially. Thus two sets of nine bundles each are formed, of which the outer set constitutes the sepal bundles, each sepal receiving three bundles and the inner set forms the vascular connections to the petals, each petal also receiving three bundles (Figs. 11 and 12).

In the above description attention is confined only to what may be regarded as a typical vascular structure at the base of the gynoecium with a peripheral set of nine bundles (combined sepal-petal traces) and an inner set of six bundles (for the six carpels). But sometimes there is seen an extra bundle in the peripheral set and this is placed close to and slightly towards the inside of one of the main bundles from which it is evidently formed as a branch. This represents an early tangential splitting of one of the main bundles of the peripheral set



FIGS. 1 and 2. Transverse section of the scape of the pistillate flower. FIGS. 3 and 4. The fusion of the two large central vascular bundles and the formation of branches from these. FIGS. 5–7. The departure of the vascular bundles to the spathes and the formation of the six large central bundles (marked *1–6*) and the outer set of nine bundles (marked *a–f*) which are the combined vascular traces to the sepals and petals; the six large central bundles are arranging themselves regularly as an inner ring and form the vascular supplies to the six carpels. FIGS. 8–10. Sections at higher levels showing the arrangement of the bundles; in Fig. 10 the formation of the dorsal, lateral and ventral bundles is seen and an extra sterile carpel is also marked (*St.C.*). FIGS. 11 and 12. Section higher up showing the separation of the two sets of floral leaves and the tangential splitting of the combined sepal-petal traces; the paired stigmatic lobes are also shown. FIG. 13. Diagrammatic longitudinal section of the pistillate flower to show the vascular connections to the different floral organs. *Sp.*–spathe; *L.B.*–lateral bundle; *D.B.*–dorsal bundle; *V.B.*–ventral bundle; *Ov.*–ovule; *Sc.*–mucilage-secreting scales; *K.*–calyx; *C.*–corolla.

even as low as at the base of the gynoecium, while the others divide only very much higher up where the actual separation of the two sets of floral leaves takes place. Similarly extra bundles are also met with in the inner set of bundles forming the vascular connections to the carpels. In such cases the gynoecium shows seven or eight carpels instead of the usual six and the extra bundles are related then to the additional carpels. These extra carpels appear to be invariably sterile and in Fig. 10 such a sterile extra carpel is shown (*St. C.*).

Above the ovary each carpel forms two stigmatic lobes which appear paired in a transverse section and the number of such pairs corresponds to the total number of carpels making up the gynoecium (Figs. 11 and 12). The pairs of stigmatic lobes are arranged in a circle forming a large cavity in the centre as a pollen collecting chamber. The carpellary vascular bundles reach only the lower portions of the stigmatic lobes, but disappear higher up.

Svedelius[2] regarded that the gynoecium in *Enalus acoroides* is "composed of six carpels which form a unilocular ovary divided into six cavities" and that the "parietal placentæ project to the middle of the ovary and are, as in so many of the Hydrocharitaceæ, split quite into two lamellæ". Following this, Cunningham[3] also described "a syncarpous unilocular inferior ovary with from 6 to 8 carpels". But Troll[4] has recently shown that the gynoecium in this, as well as in the other Hydrocharitaceæ, is really apocarpous and that it appears to be syncarpous only apparently. He designates such a gynoecium a pseudo-coenocarpous one. Further, he states that in the attainment of this condition the floral receptacle, which is said to become cup-like, is fused with the dorsal portions of the otherwise free carpels. On the other hand, the present anatomical study suggests that the outer wall of the gynoecium is made up of the fused basal portions of the two sets of floral leaves, for, the nine peripheral bundles which are recognizable at the base of the gynoecium are really combined sepal-petal traces, and the receptacular vascular tissue ends below the level at which these bundles and the main vascular supplies of the carpels are formed. The outer floral whorls are adnate to the carpels over a considerable distance and are free only above the gynoecium, which thereby has become not only pseudo-coenocarpous, but also inferior. Recently, Joshi and Pantulu[5] have shown from a study of *Polianthes tuberosa* Linn. that the inferior ovary in the Amaryllidaceæ is the result of fusion of the basal portions of the outer floral whorls with the carpels. Eames[6] states: "The inferior ovary represents adnation in its extreme form. Comparative studies, made with the understanding that fusion of organs ultimately brings about fusion of the skeletal tissues also, demonstrate that the inferior ovary in nearly all—perhaps in all—families has resulted from the adnation of the outer floral whorls to the carpels." Finally, it may be stated here that the central axis of the flower which Troll[4] represents in his figures as a small projection at the base of the ovary in *Enalus* could not be made out in any of the preparations, though a careful examination was made through a complete series of transverse sections.

In conclusion, the writer wishes to record his sincere thanks to Prof. M. A. Sampathkumaran, Head of the Department of Botany, for his very critical reading of this paper.

S. B. Kausik.

Department of Botany,
University of Mysore, Central College,
Bangalore,
March 4, 1940.

---

[1] Kausik, S. B., *Proc. Ind. Acad. Sci.*, 1940, **11**, 83.

[2] Svedelius, N., *Ann. Roy. Bot. Gard. Peradeniya*, 1901, **2**, 267.

[3] Cunningham, H. M., *Trans. Linn. Soc. Lond. Bot.*, 1912, **7**, 355.

[4] Troll, W., *Planta*, 1931, **14**, 1.

[5] Joshi, A. C., and Pantulu, J. V., *Curr. Sci.*, 1939, **8**, 212.

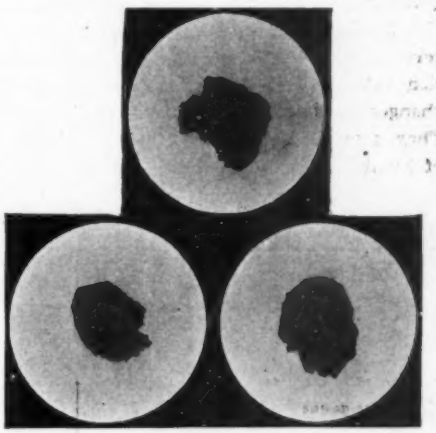
[6] Eames, A. J., *Amer. J. Bot.*, 1931, **18**, 147.

Some Chemical and Physical Properties of Water Caltrop Starch

In a previous paper[1] a method was described for the production of starch from water caltrop. Some uses for this starch were proposed and it was stated that with a view to find its suitability as a sizing and finishing material, experimental work on some of the chemical properties, and penetrating and coating power on cotton yarn, was in progress. This work has since been completed and is described in this note.

α- and β-amylose content.—The importance of the determination of the relative contents of α- and β-amylose components of the granules of the various starches has been shown by a number of investigators and has been concisely described by Thurber.[3] It appears that starches with the same relative contents of these components exhibit similarities in other properties, *e.g.*, adhesiveness of pastes and type of dextrine formed on partial hydrolysis. Accordingly, a study of the determination of the components of the water caltrop starch was made. The common procedure followed for separation of the components is first to disintegrate the starch granules and then to subject them to the influence of an electric potential difference in an electrophoresis cell when the negatively charged α-amylose acid radicals migrate towards the positive pole. For the disintegration of the starch granules dry powdered starch (25 gm.) was heated for 8 hours under constant stirring with 90 per cent. alcohol (25 c.c.), ammonium sulphocyanide (20 gm.) and distilled water (100 gm.). Frequently, the paste was tested under the microscope and when the gelatinization was found to be complete, it was allowed to cool and ammonium sulphocyanide was removed (tested with ferric chloride) by constant washing with 90 per cent. alcohol and grinding in a ball mill for about 60 hours. The washed starch was filter-pressed and allowed to dry under vacuum. The separation of the α-amylose component was carried out in an electrophoresis cell similar to that described by Taylor and Iddles[2] and Thurber.[3] A 220 volts potential difference was used. The percentage of α-amylose component recovered was 4·27. This is higher than that of the potato starch and much lower than that of the maize starch. The β-amylose content of the water caltrop starch is nearly as high as that of the white potato starch. It may be concluded that like the potato starch this starch can be used also for sizing purposes.

Penetration and coating power.—The relative penetrating and coating power of water caltrop, potato and maize starch pastes with respect to cotton yarn was compared by a method similar to the one described by Thurber.[3] Threads of No. 30 cotton yarn (stretched on wooden frames) were dipped for 3 minutes in starch paste (4 per cent.) prepared by heating starch suspension in water for 30 minutes at 98° C. and after brushing off excess of starch they were dehydrated with alcohol of graded strengths (30–90 per cent.) and embedded in colloidin-paraffin. The various cross-sections obtained are given in Fig. 1. The dark outer portion



Maize Potato

Water Caltrop

FIG. 1

Cross-sections of thread showing relative coating and penetrating power of maize, potato and water caltrop starches.

marks the extent to which the starch has penetrated the thread. They show that the coating and penetrating power of the water

caltrop starch is better than that of maize and potato starches.

J. L. SARIN.
R. L. SEHGAL.

Government Industrial Research Laboratory,
P.O. Shahdara Mills,
Lahore,
February 28, 1940.

[1] Sarin, J. L., and Mohd. Shafi, *Ind. Eng. Chem.*, 1937, **29**, 1436.
[2] Taylor and Iddles, *ibid.*, 1926, **18**, 713.
[3] Thurber, F. H., *ibid.*, 1933, **25**, 565.

On the Inter-dependence of Transpiration Rates of Leaves on a Plant

IN a paper entitled, "March of transpiration of a leaf since its measurable stage to its fall",[1] P. Parija and B. Samantarai have recorded a very interesting observation that when a leaf (attached to the plant) was enclosed in a chamber through which only dry air (0% relative humidity) was passing, its transpiration rate showed fluctuations correlated with changes in the relative humidity of air outside. They concluded, therefore, that this influence of humidity was exerted through other leaves (non-experimental and exposed to humidity changes of the outside air) and that "all the leaves of a plant are connected into an organic whole so that they influence each other in their activities, specially transpiration". This is evidently an important observation and the writer was, therefore, interested in examining the data more closely. An inspection of the curves of transpiration rate and relative humidity did not reveal a striking relationship of any type and it was thought necessary to examine the data statistically by calculating the correlation coefficients which are given in Table I.

As the transpiration rate of the same leaf was observed throughout its life the linear trend of transpiration rate with time was eliminated and partial correlation coefficients between transpiration rate and relative humidity are given in the table. It will be noted that in no case does the partial correlations approach the significant values ($P = 0{\cdot}05$) given in the last column. Moreover the partial correlations are positive in two cases (Appendices II & IV), which is contrary to expectation as the transpiration rate varies inversely with the relative humidity. It is hoped, therefore, that the authors will confirm this observation by more substantial experimental evidence.

TABLE I

Plant	Data from Appendix	Humidity conditions inside the chamber	Partial correlation coefficient	Partial correlation coefficient at 5% significant level
Helianthus annus ..	I	Not controlled	−0·311	0·444
Datura alba ..	II	,,	+0·283	0·455
,, ..	III	Controlled	−0·243	0·380
Ixora undulata ..	IV	,,	+0·225	0·304

Lyallpur,
November 27, 1939.
R. D. ASANA.

[1] *J. Ind. Bot. Soc.*, 1939, **28**, 65.

"Ascu" Wood Preservative

I HAVE read with interest your two articles on the above subject in the January and February issues of your *Journal*. I am extremely glad to hear that there is "widespread interest" in the difficulties encountered with this wood preservative, and some good will have been achieved by this publicity if the attention of Ascu users has been drawn to the fact that the *Ascu Record* has been withdrawn pending republication in a revised form. I would, however, like to draw your attention to the fact that the reasons for its withdrawal were clearly stated in the note announcing its withdrawal, and this correspondence apears to have arisen chiefly because in your editorial of January 1940, you were not able to publish the note in full.

The most important point connected with the withdrawal seems to have escaped your notice and also that of your correspondents. It is that the withdrawal was necessary, not so much as the result of the large-scale failures with Ascu-treated poles in North India, *but in order to prevent such failures in future*. The Forest Research Institute knows only too well that the failures in North India were due, in large part, to inadequate treatment, but it has not been made clear in your editorials that inadequate treatment might result from failure to evaluate intelligently some of the information given in the *Ascu Record*.

From some of your remarks it would appear that this Institute has already condemned Ascu *in toto*. This is a totally incorrect conception of the present position. What we are trying to do is to prevent future users from repeating the mistakes which have been made in the past, and if these mistakes were due in any way to some of the information given in the *Ascu Record*, the only safe procedure was to withdraw the *Record* for revision and thereby help to prevent further mistakes being made.

You say in your editorial for February 1940 that, "the withdrawal of the *Ascu Record* at this stage leaves the users of the process in a very difficult position". I am unable to agree with this contention. All users of the preservative are, I hope, sufficiently intelligent to realise that inadequate preservative treatment is false economy, and in the withdrawal notice we clearly indicated what we considered to be a reasonable and at the same time an adequate treatment. This information, as was stated in the withdrawal notice, is based on an assessment of the information available up to the present time. The users of Ascu should, therefore, find themselves, not in a "difficult position", but in a much safer position than they were formerly, and should on the whole, be pleased to have some more reliable and more up-to-date information to work on than that given in the *Ascu Record*. The readers of your *Journal* will be the first to appreciate that no invention or process can be good for all time, and that modifications are bound to be necessary as experience accumulates. The Forest Research Institute has always made it clear that the final word on Ascu had not been spoken, but one or two illustrations relative to the present discussion will perhaps make the reasons for the withdrawal of the *Ascu Record* for revision more clear to your readers.

The originator of the process mentioned in the *Record* that "any illiterate *mistri*" could work an Ascu-treating plant. This has been found by experience to be incorrect, and it was largely due to ignorance of the difficulties encountered in practice in obtaining adequate treatment that the North Indian pole failures occurred. One of these difficulties (not mentioned in the *Ascu Record*) is that connected with the changes, both in composition and concentration, which takes place in Ascu solution as the result of wood coming in contact with it. These changes vary with different species, and with some species have been found to be very considerable, with the result that the composition and concentration of the treating solution in the service tank may be entirely changed after one treatment, so much so in fact as to make the old treating solution almost worthless. Again, the originator of the process recommended a treatment consisting of a fairly

low pressure maintained for about 15 minutes. This treatment has been found to be insufficient in practice to obtain complete penetration and good absorption, even in the perishable sapwood, of some species, and it is certainly not sufficient to obtain complete penetration and adequate absorption in the heartwood of several perishable woods. Other new factors, some of which are mentioned in the withdrawal note, have also come to light as the result of experience. These new factors were not known when the *Ascu Record* was published, but the North Indian pole failures brought out the fact that they might be serious. They are not connected solely with inadequate treatment, but concern such features as the possible existence in India of arsenic- and copper-resisting fungi, the possible adverse effects of certain soil conditions on Ascu, and the chemical changes of the toxic constituents of Ascu which may take place when it comes in contact with other chemicals present in certain species of wood.

Finally, allow me to make it quite clear that this Institute has not condemned Ascu or discarded it as worthless. This will be evident from the note, which is sent out to all enquirers who ask for information on Ascu. In the Forest Research Institute's opinion, Ascu is an interesting preservative which has certain features not always found in other preservatives, but it is a comparatively new preservative which is continually presenting fresh difficulties, and until these difficulties have been studied and are more fully understood, the Forest Research Institute cannot endorse its use indiscriminately. As soon as it was realised that some of these new factors might be dangerous, and as they were not known at the time the *Ascu Record* was written, it was considered advisable to withdraw the *Record*, and to issue it later in revised form, so as to avoid repetitions of large-scale failures such as those encountered in Northern India.

L. MASON.

Forest Research Institute and College,
Dehra Dun,
March 17, 1940.

A National Research Council for India

THERE can be no two opinions about the need for a National Research Council but in a large country like ours, such a Council cannot function properly unless different Provinces and States (or some other composite units) also effectively organise and co-ordinate their research work and give it a bias towards the applied side. With the organisation of the University of Travancore, the various Scientific Units in the State, which were formerly under the control of different departments such as Education, Public Health, Industries, Agriculture, Public Works, Observatory, have been brought together in the form of a Central Research Institute under the University. A Council of Research has also been formed in which substantial representation has been given to the Development Departments of the State. Research Scholars and Fellows are appointed to investigate problems of direct value to the industry, agriculture and public health of the State. Thus the resources and the talent of the educational institutions are being harnessed for applied Research in collaboration with specialists in Applied Sciences. Sachivothama Sir C. P. Ramaswamy Iyer, the Dewan of Travancore, and the Vice-Chancellor of the University, is the Chairman of the Council of Research.

As long as the relationship between the all-India finances and the Provincial and State finances are in a state of adjustment, it will be better, in the first instance, to concentrate on provincial co-ordination of applied research so that some start is made immediately. The agency or Council which does so, will have to look to provincial finances for support and will concentrate on specific service for provincial interests. These provincial units can be later co-ordinated under a national organisation in course of time.

Institutions like the *Indian Institute of Science* can play a very important part. They should develop the "cell" system of research and investigate utility problems on the requisition of industrialists and various Provincial or State Governments.

An *All-India Council of Research* should be our aim but to achieve this object, expediency demands that we should organise the units in the Provinces and States, and on their co-ordinated strength, build the national organisation.

K. L. MOUDGILL.

University of Travancore,
Trivandrum,
March 25, 1940.

THE National Research Council should be formed immediately on the lines laid down for such bodies by other civilised countries. Its constitution should be left elastic in the beginning, so that it might be altered later in the light of experience. India cannot wait indefinitely for an all-round agreement, which would perhaps never be achieved.

It should be an autonomous department of the Ministry of Education. Scientific bodies of an all-India character should be represented on the Council. It should be financed by the Central Government, and should be subsidised by the Provinces and the States. It should place its services at the disposal of all.

It should give a direction to research from the national point of view. For instance, it can publish from time to time a list of research problems of vital importance to the nation for the consideration of research workers all over the country.

It should not interfere with pure research (knowledge for its own sake) which should be left to the universities and learned bodies. It should, however, collaborate with the latter.

The Council should set up various centres of Industrial and Technical Research at suitable places. It should see, however, that duplication resulting in the wastage of national resources is avoided.

The frequent recurrence of war in other countries makes it imperative that India should produce all the possible requisites of modern civilised life. Most of the necessary raw materials are abundantly available in the country. The National Research Council should devote particular attention to making India self-sufficient. The first step should be to develop the production of power, and the manufacture of machinery and chemicals. These are the prime factors of national existence and progress.

M. R. SIDDIQI.

Osmania University,
Hyderabad,
March 15, 1940.

The Rights of Man

THE important leading article on this subject in the last issue of *Current Science* calls for comment and discussion. Such discussion if it is not to be futile must needs soon get down to fundamentals.

In the first place as in every debate we must be clear about our definitions. Mr. Wells is apt to confuse "Homo Sapiens" with "probably arboreal", much as the Psalmist in one mood speaks of man as being evanescent as the "flower of the field" and in another as being "little lower than the angels". The difference surely depends on how far enlightenment has risen in the consciousness of the immediate manifestation of "Man".

"Probably arboreal" voyaging in fear, astride of a log, could have built the "Queen Mary" *had he known enough*. All the principles of engineering, physics and chemistry involved were available, but the sun of enlightenment had only faintly appeared above the horizon of his consciousness.

"Progress" is the revelation of ever present Truth. Because the sun is temporarily behind a cloud it does not mean that darkness must prevail. Twice two remains four.

As has been previously remarked, it seems a pity that H. G. Wells chose for his intellectual discipline the subjects of Geology and Biology rather than the more exact experimental sciences of Chemistry and Physics.

He would then perhaps have seen rather further than he seems willing now to permit himself. Granting his great virtue of honesty, which may protect him from final disaster, it

is to be regretted that his perception is apparently so limited.

There must be some fixed basis of thought if we are to arrive at anything but a sterile scepticism. A child who can multiply accurately up to ten times may not be able to deal with problems in higher mathematics, but without such exact foundation he can deal with *no* problems accurately. There is a story of a missionary who came across a band of jungle people quarrelling over the sharing of a load of pineapples. When he, with the aid of very elementary arithmetic, divided the pineapples among the company in equal shares, he was at once worshipped as a god. He however had not *invented* the multiplication table. There never, in fact, has been a time or place where twice two is not four.

It would seem that H. G. Wells like so many others is afraid of *words*.

In his *World Order*, where he expresses a much happier view-point than in *Homo Sapiens*, he speaks of the coming revolution as operating on a very wide front, so that it cannot be said just when and where it is active. One is naturally reminded of an older and more authoritative utterance:—

> "The Kingdom of God cometh not with observation. Neither shall they say Lo here or lo there! for behold the Kingdom of God is within you."—Luke 17 : 20–21.

So we may well take heart and watch the *thought* of the world.

H. G. Wells graphically describes the accelerated tempo of scientific discovery. We should remember that the starting point of the rapidly mounting graph is to be found in the Atomic Theory of Dalton which made possible quantitative chemistry, and the determination by Joule of the mechanical equivalent of heat, the reasoned consequences of which linked up all phenomena under an exact and *demonstrable* principle.

H. G. Wells makes much of the failure of the churches, confusing "creedal" Christianity with the two fundamental commandments.

After all these two fundamental commandments of Christianity appeal equally to such widely different individuals as Sir William Bragg, President of the Royal Society, and George Lansbury, the Labour Pacifist. "To love the Lord thy God with all thy heart and with all thy *mind*" surely means thou shall love Truth, Wisdom, Justice, Love and Beauty with all thy heart. "To love thy neighbour as thyself" is indeed a commonsense conclusion if society is to preserve itself at all.

Unfortunately the power of words still obtains and "God" to many signifies "the magnified and non-natural man" of Matthew Arnold.

When creedal Christianity is stripped of its false beliefs and pagan elements, just as chemistry shed phlogiston, and physics perpetual motion, and so becomes a demonstrable science, there will be as remarkable an acceleration in the understanding of Reality, as there has been in the knowledge of phenomena.

We may remember that the Founder of Christianity gave his disciples *power* over all evil. This is not merely the negative conception of the "pacifist" or of the disciples of "non-violence", but the actual demonstration of the ever present "Kingdom of God" manifest in the "natural" world.

The many "reforms", which all "men of good will" desire to see, will come as the inevitable outgrowth of this Kingdom, once it is established on a basis of *understanding*, instead of superstition, of creedal beliefs, or of merely personal following.

Mr. Wells himself might feel the sense of "frustration" less acutely if he suddenly realized that a pianist is not called upon to *compose* music of the standard of Beethoven but only to *play* it as nearly as possible as Beethoven would wish it played; and that in the midst of the manifested evil of the present time, we may continue to hear the voice still calling: "Be not afraid of them that kill the body and after that have no more that they can do" (Luke 12 : 4).

GILBERT J. FOWLER.

Madras,
April 17, 1940.

OBITUARIES

Dr. (Miss) C. MINAKSHI, M.A., Ph.D.

WE regret to bring to the notice of our readers the sad and premature death of DR. (MISS) C. MINAKSHI, M.A., PH.D., Assistant Professor of History, Maharani's College, Mysore University, on the 3rd March 1940, at the early age of 33. Born in a Tamil Brahmin family of Conjeevaram, early in her age she took to study on Western lines, a course which, for a lady, the orthodox Brahminism of her time did not view with favour, but which paved the way for her distinction. After completing her undergraduate studies in the *Women's Christian College*, Madras, she prosecuted her post-Graduate study in History at the Madras Christian College, from which she was the first lady to take the M.A. Degree, which she took with distinction. In recognition of her merit, the University of Madras granted her a scholarship for advanced research in Indian History in 1931 for two years, which was extended for an additional term of a year in consideration of the importance and value of her researches. She selected as her subject for investigation the Administration and Social Life under the Pallavas, including Pallava Art, and the valuable work done by her in advancing the knowledge in the subject earned for her the Ph.D. Degree, a distinction she was the first lady to receive from the University of Madras. A large part of the results of her investigations was published by the University in the form of a book entitled *Administration and Social Life under the Pallavas*, a work which has been well received by the world of scholars and the lay public alike, as bearing a high mark of perfection and scholarship. The Madras University gave her further opportunity to conduct research in other important aspects of ancient South Indian History by granting her a Fellowship in 1937 for a year, an opportunity which she made excellent use of, in investigating into the history of Buddhism in South India. The archæological tours she conducted in connection with her new work, and the discoveries she made, attracted the attention of the Archæological Department of India, who, recognising her capacity and erudition, entrusted to her the task of preparing Archæological Memoirs on the Historical Sculptures in the Vaikuntha Perumal temple and the Kailasanatha temple, Kanchi. It is with extreme regret that we have to note that before the results of her varied researches could be published she has been snatched away from this world.

It is sad to contemplate the qualities of a person who is no more. In the death of Dr. Minakshi, who was known to be a musician of a high order, a scholar at once brilliant, painstaking and conscious, and a lively personality characterised by gentle and straightforward behaviour, South India has lost a distinguished and valuable savant whose life was full of promise.

Professor R. S. TROUP, C.M.G., C.I.E., D.Sc., M.A., F.R.S. (1875–1939)

FORESTERS the world over will mourn the demise of PROFESSOR R. S. TROUP who passed away at Oxford last October, a few months before he was due to retire from the Chair of Forestry. His contributions to the science of Forestry were many and varied and, he was one of the most powerful influences in moulding forestry policy, education, research and organisation within the British Empire.

Troup was educated at Aberdeen and at Coopers Hill where he carried away a number of coveted prizes. Like many another leading Empire forester, he spent his apprenticeship years, so to speak, in India serving in the I.F.S. from 1897 to 1917. After the first nine years in Burma (he had the distinction of preparing the first stock map for a Burma Working Plan), he was selected for Service at the *Forest Research Institute*, Dehra Dun, where his aptitude for sylvicultural research found ample scope for development. Later, he served as Timber Controller to the Government of India during the World War. And, in 1920 he was selected to succeed Sir William Schlich as Professor of Forestry at Oxford. In 1924, he became the Director of the *Imperial Forestry Institute*, Oxford. Professor Troup thus carried the very heavy burden of organising the teaching for the undergraduate and post-graduate forestry students at Oxford, of directing research and of training the probationers for the various Empire Forestry Services and in

every one of these departments he introduced innovations and left the mark of his dominant personality. He was frequently commissioned as an expert consultant on Empire forestry problems, his knowledge of which was probably unique. In the midst of so busy and strenuous a career, he found time to write several books on Forestry, his *magnum opus* being *The Sylviculture of Indian Trees*. He was a regular and prominent member of the Empire Forestry Conferences. He was on the Governing Council of the *Empire Forestry Association* and also served on their Publication Committee.

In 1920, Troup was made a C.I.E. for his services in India. Six years later, a signal honour was conferred on him by his election as an F.R.S. in recognition of his contributions to the Science of Forestry. In 1934, he received the C.M.G.

REVIEWS

Research on Grassland, Forage Crops and the Conservation of Vegetation in the United States of America. By Dr. R. O. Whyte. (Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth, Great Britain) (Herbage Publication Series, Bulletin No. 26), 1939. Pp. 113. Price 5*sh*.

It is not very long since the problem of the improvement of grasslands received serious attention. Within the last two decades and a half the progress made has been astonishingly great as a result of the impetus received during the World War. The keen interest taken in this all-important problem of agriculture, since the war is evident in the establishment of an International Grassland Association. Four International Grassland Congresses have so far been held at different places in Europe. And this year in September, the fifth would have been held at Amsterdam, but for the new world catastrophe.

It is but natural, that such a wide problem of great economic importance should necessitate surveys of the work being done in different parts of the world, from time to time. In 1929, Dr. Woodman gave a brief survey of the recent pasture research in Great Britain (*Trop. Ag.*, 6, 12). In 1930, Dr. McConkey of Ontario Agricultural College was commissioned by the Empire Marketing Board to survey and report on "Recent Advances in Pasture Management". This appeared in the form of a valuable monograph (No. 43 of the E.M.B., 1931). In 1934, the Imperial Bureau of Plant Genetics issued a bulletin (No. 14) on "Grassland Research in Australia" and thus carried a stage further the work of survey. And now comes from the same source another valuable bulletin (No. 26) on the recent work in Grassland and Botanical Survey in the U.S.A. Unlike the preceding monographs on this subject, the present one includes in it not only work on the improvement of grassland but also on the conservation of vegetation. It has therefore, an additional value of its own.

A glance at the contents of this bulletin will convince the reader of the magnitude of the work done by Dr. Whyte in providing us with a summary of the work and activities of no less than 46 state research stations spread over the country, and of agricultural and forest services. To present within a short space of hundred pages in a clear form so as to give the reader a true picture of these extensive activities is no easy work. Dr. Whyte has so ably prepared it that he deserves our congratulations.

Attention may be drawn here to some of the salient features of this compilation, especially (i) to the organization of the U.S. Regional Research Laboratory, State College, Pennsylvania which will probably be "one of the leading centres throughout the world for the study of the problems of humid temperate pastures"; (ii) to the work of Dr. Clements on climax, succession and conservation, which has resulted in the discovery of the fundamental laws concerning the growth of plants in relation to their various environmental factors. Thus it has been found that of the three factors, water, light and nutrients, the first is the most important qualitatively whereas the effect of the latter two is mostly quantitative; (*iii*) to the important section of the U.S. Soil Conservation Service. The problems covered range from

hydrologic phases of farm irrigation and land drainage, revegetation in the great plains, crop-land, orchard, pasture and range management; (*iv*) the survey of the pasture regions of the U.S.A. and the attempts made at improvement of the important types of natural and foreign grasses not only by breeding but by studying their environmental conditions. Thus are evolved varieties of grasses which are (*a*) resistant, (*b*) able to prolong their growth during summer, (*c*) better both from palatability and nutritive points of view and (*d*) resist extreme dry conditions of soil.

In conclusion a word must be said about the importance of this bulletin to India. We hope it will be as widely read as it deserves to be and those at the helm of the agricultural activities in India would try to take the initiative of putting the problem of the improvement of Indian grasslands on a scientific basis by opening special Grassland Research Stations and Provincial Botanical Surveys. Let not the world think that we are slow at taking advantage of the work done in this all-important problem especially at this time when we have at the helm of affairs one who takes so keen an interest in Indian agriculture and who has initiated the movement of cattle improvement. The work so far done in India may be said to touch hardly even the fringe of the work done in the rest of the world. The question of cattle improvement, grassland improvement and conservation of vegetation are concomitant problems and unless and until the latter two problems are solved, the first must remain where it is to-day.

F. R. BHARUCHA.

Garnets and Their Rôle in Nature. Lectures delivered by Sir Lewis Fermor, O.B.E., D.Sc., F.R.S. (The Indian Association for the Cultivation of Science, Calcutta), 1938. Special Publication No. VI. Pp. 105. Price Rs. 2–8 or 4*sh.* nett.

To an ordinary student of Geology, Garnet is one of a hundred other minerals which occur in the rocks of the earth's crust and with apparently nothing very special about it; but in the hands of a master geologist like Sir Lewis Fermor, a detailed study of this one mineral in all its aspects can be made to throw light on some of the most fundamental problems in geology. How this is possible has been elaborated by Sir Lewis Fermor in the course of his lectures on "Garnets and their Rôle in Nature" to the Indian Association for the Cultivation of Science, as its Ripon Professor for the year 1937. After giving in his first lecture a full account of garnet as a mineral and its physical, chemical and optical properties, Sir Lewis deals with garnets as constituents of rocks in Lecture 2. The occurrence of garnet in different types of igneous, sedimentary and metamorphic rocks has been noted, and special importance has naturally been attached to its 'chief home' in Nature—the metamorphic rocks. The origin of garnet in these rocks has been fully discussed in the light of recent views expressed by such exponents of studies in metamorphism like Grubenmann and Harker.

The third and last lecture of the series on "The Infra-Plutonic Shell of the Earth and speculations relative thereto" is perhaps the most interesting and thought-provoking. Starting from the ideas reviewed in the two previous lectures, Sir Lewis Fermor here proceeds to point out how they can be used and interpreted to provide explanations of some of the major problems of geology such as, (*i*) the fact that the basaltic lavas of fissure eruptions were probably super-heated, (*ii*) isostatic adjustments of mountain and plain, (*iii*) the explosive origin of deep-seated earthquakes, (*iv*) continental drift and (*v*) the origin of the chondrules of chondritic meteorites. This whole lecture is very fascinating reading and reveals the versatile outlook of its author.

In assessing the value of a contribution on such highly speculative and controversial problems, the question is not whether we are prepared to accept every one of the author's conclusions; what we must recognise is the remarkable way in which starting from known premises, arguments have been developed along a particular line of reasoning, leading to certain important and far-reaching conclusions, which, if not readily and wholly acceptable, are at least worthy of serious consideration. As Sir Lewis himself puts it, Garnet has always been a sort of a 'talisman' to him during the last 25 years enabling him to understand or interpret the speculative aspect of geological studies; and the present lectures embodying his considered views on this subject form a valuable contribution to the progress of geological thought.

L. RAMA RAO.

Practical Microscopical Metallography. By R. H. Greaves and H. Wrighton. Third Edition, revised and enlarged. (Chapman & Hall, Ltd., London), 1939. Pp. 272. Price 18*sh*.

The first edition of the book which appeared in 1924, was intended to provide, within a small compass, a set of typical photomicrographs, suitably annotated, and accompanied by an account of such related matters as might occupy the students devoted to microscopical work. In the second edition several sections were enlarged, especially those dealing with photomicrographic technique, the structure and constitution of alloys, alloy steels, the micrographic examination of steel and of copper alloys, and a new chapter dealing with low-power photomicrography and macrography was added. In the present edition several sections dealing with the structure and constitution of alloys have been rewritten and expanded. Latest developments in illuminants, colour screens, microscopy with deep-blue light and ultra-violet light have been referred to. Some additional photomicrographs taken with new equipments have also been added.

The book is well written and prepared, and should prove useful not only to students of metallurgy but also to engineers and other users of metals who desire to familiarise themselves with the microscopical method of examination.

J. S. VATCHAGANDHY.

Elements of Geology. By William J. Miller. Second Edition. (Chapman & Hall, Ltd., London), 1939. Pp. x + 524. Price 21*sh*.

The fact that the first edition of this book published in 1931, has had to be reprinted thrice within the next seven years shows how popular this publication has been among students of geology. The second edition which has been just published has been thoroughly revised and enlarged, embodying a number of features which go to enhance the value and popularity of the book. Being written by one who possesses considerable experience as a teacher of geology, the treatment of the subject-matter is such as to leave a clear and vivid impression on the mind of the student of the facts and phenomena described; and the large number of beautiful illustrations—sketches, block diagrams, and photographs—further assist the student to understand what he is reading about. The first part of the book covering about 275 pages, deals with Physical Geology in all its aspects and gives an account of the various dynamical agents operating on the earth's surface, and the manner and results of their action. The introduction of a chapter on the "Instability of the Earth's Crust" almost at the very beginning of the book is a very good idea since "it is very important that the student should, early in his study of geology, be convinced of the fact that crustal disturbances (often profound ones) actually do take place, because this is one of the most fundamental tenets of the science." The second part which covers another 250 pages, deals with Historical Geology, with reference to North America, and follows the usual procedure of first describing the general principles of stratigraphy and then giving a description of the rocks and fossils of the different periods in their chronological order commencing from the oldest Archæozoic era. A valuable and welcome feature of this part of the book is the large number of palæogeographic maps, based on those of Bailey Willis and Charles Schuchert. Talking about the cause of the Quaternary Ice Age, the author briefly reviews the several hypotheses, and rightly concludes: "We may say that, as is true of so many other great natural phenomena, no one hypothesis or explanation is sufficient to account for all the features of glacial epochs. Probably several or all, or at least parts of several or all, of the above hypotheses must be properly combined in order to explain the phenomena of glaciation, and hence it is more readily understood why great glacial epochs have not been more common throughout the history of the earth."—thus revealing an attitude of mind which all those engaged in the discussion of this and other similar controversial problems will do well to cultivate.

Both in its appearance and the exposition of its subject-matter, the book is neat and attractive.

L. RAMA RAO.

Experiments in Plant Physiology. By W. E. Loomis and C. A. Shull. (McGraw-Hill Publishing Company, Ltd., London), 1939. Pp. 213. Price 12/-.

As the authors of an earlier and more comprehensive work, Drs. Loomis and Shull are already well known to the botanical world. The present work is simpler in scope.

The more difficult experiments have been omitted and some new ones on hormone action included. The authors very modestly call the book as one designed for elementary students only. The reviewer feels that anyone who has intelligently gone through the whole course of exercises (167 in all) will get a good grounding for research work in the subject. There are selected references to original literature, mostly American, and a useful bibliography.

A characteristic feature of the book is that it does not anywhere tell the student what he will find or why. He is given clear and concise directions for the experiments but left to think out for himself the "why" and "how" of the questions that will naturally arise to an inquisitive mind. In other words, he must learn to be his own Socrates. This is bound to be disconcerting to those accustomed to cramming, but the better ones will almost unconsciously acquire a far more thorough understanding of the functions of plants and the principles which underlie their life processes, than they could by merely attempting to memorize a list of facts.

The book is commendable in every way.

P. M.

Practical Chemistry. By N. M. Shah. Fourth Edition. (Students Own Book Depot, Dharwar), 1938. Pp. 69 + iii + 9. Price Rs. 2–4–0.

This is an elementary text-book of Practical Chemistry which attempts to meet the requirements of the science students of the Intermediate course. At the commencement alone, hints about the proper use of apparatus are given and this is followed by a few gravimetric exercises. Next the preparations of a few gases are given, and in the same section the preparation of a few more—methane, acetylene, nitrous oxide, hydrogen chloride—could also have been included. The preparation of certain important inorganic compounds like potassium nitrate, alum, ferrous ammonium sulphate, cuprous and cupric oxides and cuprous chloride might have been included. In volumetric analysis, acidimetry, alkalimetry and oxidation reduction methods alone have been dealt with but the analysis involving the use of sodium thiosulphate and silver nitrate solutions could be included.

A very detailed scheme of qualitative analysis of simple substances has been given at the end, and there is also a chapter on organic analysis dealing with the detection of simple organic substances. Students undergoing training in Chemistry for the Intermediate Examination are likely to find the book quite useful for their course in practical chemistry.

M. SESHAIYENGAR.

Intermediate Chemistry—Inorganic and Physical. By Frederick Prescot. (University Tutorial Press, London), 1939. Pp. 828. Price 12*sh.* 6*d.*

This is a suitable text-book of General and Inorganic Chemistry answering to the requirements of the Intermediate students in science and the first year Medical students. The book is divided into two parts. The first part deals with all the theoretical portions and suitably covers the requirements of the B.Sc. pass degree. The chapters dealing with Kinetic theory, Hydrogen-ion Concentration and Colloidal solutions will be specially useful to students of Medicine and Biology. The second part is devoted to descriptive inorganic chemistry and is rightly arranged in accordance with the periodic table. The preparations of important inorganic compounds have been satisfactorily dealt with. At the end of each chapter important questions pertaining to the topics dealt with and occurring in various University examination papers are given. The work is complete and up-to-date and could be read with advantage not only by the Intermediate students and the first year Medical students, but also by those who appear for a B.Sc. pass degree examination.

M. SESHAIYENGAR.

Elements of Physico-Pharmaceutical Calculations. Edited by M. L. Schroff and G. P. Srivastava. (The U.P. Pharmaceutical Association, Benares Hindu University), 1940. Pp. 281.

This book is the third volume of the *Indian Pharmaceutical Series*, edited by M. L. Schroff and G. P. Srivastava. Professor Schroff, the author, is a pioneer of Pharmaceutical Education in India, having been largely responsible for the introduction of a course in Pharmaceutical Chemistry in the Benares Hindu University—perhaps the first University in India to institute a course of instruction in this important subject which has been neglected so long. The book consists of several chapters dealing with various branches of Physical Chemistry such as

"Solutions of Electrolytes", "Indicators in Acidimetry and Alkalimetry", "Oxidation and Reduction", etc., followed by two chapters on "Miscellaneous Calculations" and "Evaporation and Distillation". There are also a number of numerical exercises which will be useful to students. The matter is presented in very clear language; but as most of the information given in the book, except perhaps, in the last two chapters, can be found in any standard work on Elementary Physical Chemistry, one wonders if there was any need to add to the already large number of books, good, bad and indifferent, on the subject. The title of the book is somewhat misleading and if a second edition is called for, it would perhaps be advisable to change it to "Elements of Physico-Chemical Calculations for Students of Pharmacy". This will certainly be a more appropriate title than the present one, which, in addition to being misleading, sounds rather clumsy. The book is likely to be very useful to students studying for a degree examination in Pharmaceutical Chemistry.

C. V.

---

(1) Biology for Junior Forms. By M. R. Lambert. (MacMillan & Co., London), 1939. Pp. 320. Price 3*sh.* **(2) A School Course of Biology.** By L. J. F. Brimble. (MacMillan & Co., London), 1939. Pp. 469. Price 6*sh.*

These two books are published by MacMillan as a course of Biology. Biology is intended to supersede in the schools the old three courses of Natural Science, Zoology, Botany and Physiology. Discarding the method of studying only one or two animals thoroughly, and taking instead a more universal view of plants, animals and man, Biology gives the pupils a knowledge far broader and more useful. Thus the student will leave the school better prepared to face life; and the physical world remains no longer a closed book to him.

MISS M. R. LAMBERT has given in her book an introduction to the study of Biology. Hers is, as a matter of fact, the third of a set of three elementary books on this subject; but as Miss Lambert has written them in the concentric system, the third is by itself a complete introduction to Biology. And it is nothing more than an introduction.

The first part contains general notions on plants, their organs, functions and uses, written with clearness and simplicity. The second part, the most interesting, deals with the chief groups of animals, insisting in each case on the main characteristics of functions and habits. Here we have the best pages about the life, and customs of ants, birds, and spiders. The matter is well chosen so as to impress the young minds with the wonders of nature. The last part gives a few notions of Physiology.

The book is all written with uncommon simplicity of style. Abundance of fine pictures, description of simple experiments, and homeliness of reflections make it very interesting for the young.

Mr. L. J. Brimble's volume is simply wonderful. Although it begins somewhat heavy with long terminology, it becomes, however, soon very interesting. It is a brilliant book, complete, rich and absorbing. The first impression that the many scientific terms might overcome the student is later on corrected by a lighter and attractive style.

The author has avoided division into Botany and Zoology, and has adopted the comparative method. After an introduction to plants and animals (P. I) there follow, in P. II, P. III, the two main subjects: How plants and animals live and how they reproduce themselves. The human being comes next (P. IV) with a splendid chapter on "Man in relation to plants and other animals". In the last two parts the author deals with living things and their environment, and the history of living things. They are really interesting.

The author must be congratulated for his success in bringing out such a beautiful, practical and complete book. With the numerous experiments suggested at the end of the chapters, with many questions taken from examination papers, with his more than 350 fine pictures, the author has given us not only an excellent text-book, but a volume which would find a good place in the home and in any library.

If I may make a suggestion, perhaps a few more notions on edible fruits and medicinal plants would be practical. The diagram on carbon dioxide on page 166 might be made a little clearer. The slip on page 5, where stalagmite is said to be "usually produced by the evaporation of water from a solution of sodium bicarbonate" (it is mainly of calcium carbonate) might be corrected.

F. AIROLDI, S.J.

The Quality of Coke. By R. A. Mott and R. V. Wheeler. (Chapman & Hall, Ltd., London), 1939. Pp. 464. Price 36*sh.* net.

This valuable record of investigations into the properties and testing of coke is really the second Report of the Midland Coke Research Committee of the Iron and Steel Industrial Research Council of Great Britain. (The first Report appeared in 1930 and was published by The Colliery Guardian Coy., Ltd.)

These two volumes undoubtedly stand supreme in the library of the fuel technologist, so far as bibliography of coke is concerned, and the appearance of this second volume is particularly opportune on account of the interest at present taken in the possibilities of Low Temperature Carbonisation in India and of improvement in the quality of soft coke, as well as in the extension of its use as a domestic fuel.

A comprehensive review of this work would itself become a text-book. Space permits of only a brief reference to various important features. It begins by a review of the existing standards for commercial coke, this being classified according to the most important uses. The difficulties facing the investigator in testing cokes for domestic and similar uses are specially referred to. There is an excellent chapter on the whole process of coking, the reader being taken through the stages of pre-softening, decomposition and softening, swelling and agglomeration, solidification and hardening. One statement, on page 16, is of special interest to the Indian Coal Industry. It is to the effect that there is insufficient oxidation during storage of many coals, especially those of high swelling power, even during a year, to affect their properties, whereas the swelling power of low rank coals and their ability to form a strong coke may be seriously impaired by undue length of storage time, it being, therefore unwise to store such coals, especially if of small size, for long periods.

The title might suggest a somewhat restricted scope, but there is a wealth of valuable information, and the research worker will find many unexpected pieces of information and hints for research technique. The rôle of fusain in coke making has in recent years come in for much attention on the part of research workers, and Chapter XIII contains a useful Appendix on the Recovery of Fusain for experimental (blending) purposes as well as on its estimation in coals.

The whole question of blending of coals for coking is also fully dealt with.

Dr. Mott is to be congratulated on the appearance of this additional evidence of his high technical and scientific ability. The diction, systematic arrangement, grammatical style, and method of marshalling facts and arguments are a model for other scientific writers to follow.

Appropriate reference is made to the deeply regretted death of the joint investigator and author, Dr. R. V. Wheeler. C. F.

Life's Beginning on the Earth. By R. Beutner, M.D., PH.D. (Chapman & Hall, Ltd., London), 1939. Pp. 222. 12*sh.* 6*d.* net.

When did Life commence on this planet? Notwithstanding the tremendous progress achieved by the modern sciences, no definite and fool-proof answer has been forthcoming to this and allied questions—such as: How did Life originate? What exactly constitutes Life? and so forth. Any volume or publication that is likely to throw light on the many complicated problems touching the origin of life is entitled to a sincere welcome at the hands of those interested in scientific pursuits. Dr. Beutner has attempted in the volume under notice, to trace the beginning of Life on this planet strictly proceeding on scientific lines of investigation and depending for verification and demonstration of results on scientific methodology. In the course of a brief "Preface", the author observes that in the year 1933, he ventured on a prophecy that "Life ... in spite of all its complexity, seems to be no more than one of the innumerable properties of the compounds of carbon" (*v. preface*) and claims that within the five years that had elapsed, "part of it has come true". In a virus responsible for the causation of infectious diseases, which marks a living entity and at the same time a substance that can be secured in pure form as crystals, one would readily detect "an enzyme capable of regenerating itself in a natural environment". Such was the discovery made by Dr. W. M. Stanley, of the Rockefeller Institute at Princeton, New Jersey, and Dr. Beutner has attempted a "plain" presentation of all pertaining facts. The "First Approach" examines in detail the phenomenon of Crystallization and its

relation to Living Growth. In the "Second Approach", one is told that Life is just carbon's outstanding property. The "Third Approach" explains that the Ocean is the cradle of Life, and emphasizes the importance of Salt and Water for the growth of Life. In the "Fourth Approach", the view is elaborated that the animal is just a machine. Two brief discussions occur about "Artificial Parthenogenesis" and the "Mitogenetic Rays". Results are summed up in the "Epilogue".

While there must necessarily exist difference of opinion regarding the success of Dr. Beutner and others working in that line of investigation, in rendering an adequate or convincing answer to the permanent and persistent problems—Whence and How did Life Originate? there must be absolute unanimity among scientists in thankfully acknowledging the undoubted value of the author's work as a significant contribution in the direction of finding, if at all it is possible to find any, a solution to the specific problem of the origin of Life. The magic word is ENZYME! Enzymes explain the evolution of Life on this planet. What are these Enzymes? Dr. Beutner remarks perfectly pathetically I should suppose—"... Although 300,000 compounds of carbon have been made, the chemical make-up of the most important substance of the living world, the enzymes is *shrouded in mystery*" (p. 126).

I would like to underline *two* unwritten Laws which sincere and honest scientists should never seek to violate according to Dr. Beutner. (1) Scientists worth their salt should never draw suspicious conclusions as, for instance, "moving oil-drops represent a form of life" (p. 184). (2) Secondly, unverified results should never be published in the lay press, as such premature and preverificational publication of results is sure to lead to universal misconception. In this connection, Dr. Beutner refers to the sensational account published by a reporter of the *Chicago Tribune*, who after a microscopic observation of oil-drops from fresh brain-material, believed that artificial life had been created!

I shall permit myself only one more observation. Dr. Beutner towards the conclusion of his arresting volume remarks that scientists have begun to see life "is not a miraculous separate entity imposed on our earth by a spirit or an *invisible something*" (italics mine). His own attempted explanation carries us no nearer any intelligible solution. "Life", the learned Doctor says, "is one of the developments of the Universe governed by the general laws of Nature" (p. 222). Which, pray, is not such a development? Matter is one such. Life is one such. If Life is explained or interpreted as just a Devil's-Dance of electrons and enzymes, or just a development governed by the Laws of Nature, the explanation bereft of all scientific terminological obscurantism means that LIFE IS LIFE. No critic or reviewer can be blamed if he refuses to evince any enthusiasm over such explanations which are, at best, mere twists in terminology, but, which never succeed in laying bare the HOW of it. Dr. Beutner quotes approvingly the views of a well-known scientist. A modern scientist first of all inquires what precedes a phenomenon to be explained and what follows after it. That would seem to be the essence of scientific explanation. WHAT then precedes ENZYMES? WHAT follows after? I do not believe that Dr. Beutner has rendered direct and straight answers to the cardinal questions. Nevertheless, Dr. Beutner's is a masterly survey of the conclusion of modern Biology, Chemistry, and other allied sciences which makes a bold bid for coming to grips with the problem of the origin of Life on this planet. On this masterly survey laymen and scientists must congratulate him.

R. NAGA RAJA SARMA.

The Criminal in Society—A Review of the *Fundamentals of Criminology*. By Henry T. F. Rhodes. (Lindsay Drummond Ltd., 6, Buckingham Street, London, W.C. 2), 1939. Pp. 280. Price 7*sh.* 6*d.* net.

Since man's adroit attempt to eat the fruit of the forbidden Tree, the problem of Crime and the Criminal has always confronted in systematic social organization, and H. T. F. Rhodes, of the *Institute of Criminology*, University of Lyons (France), and of the *International Academy of Criminology*, has discussed the highly interesting and intriguing question of the possibility of reformation of the criminal with a view to his humanisation. Preliminary definitions and the scope of Criminology are dealt with in the opening chapter. The different schools of Criminology are examined in the next. The Statisticians, The Positivists, The Environmentalists, The

Bio-Sociologists, and the Indeterminists or the Moralists have come in for some searching examination at the hands of the author. "The Criminological Effect" is the subject-matter of the third chapter. What is precisely criminal sociology? What may be the nature, the conditions and the limits of criminal responsibility? What is the significance of Punishment? These questions are discussed fully in this chapter. In the fourth (concluding) chapter, Crime is examined in reference to social order. Authoritarian, Democratic, and Socialist Societies reveal characteristic crimes and criminals, and have adopted corresponding remedial measures.

The problem of Crime and Criminals can be tackled proceeding along different lines of approach. There is the Psychological approach (including the psychiatric and psychopathological). There is the legal approach. Finally, there is the Ethical or the Moral approach. While it is easy to multiply many other approaches, they can all be conveniently subsumed under the three practically universal approaches.

The psychological approach is the most difficult, yet, it is the most interesting. Unless light is thrown on the constitution of the criminal mentality, and unless again the deep springs of action or motives are tracted, it would be impossible to understand crime and criminals. In the first place, it must be remembered that the criminal is *first a human being*, and *only next a* criminal. The sancrosanctity of human personality as such should be respected. Of course, under the storm and stress of modern competitive struggle for existence, and under modern conditions of social organization, those in authority would naturally feel inclined to subject the criminal to summary treatment. A criminal should be summarily clapped into prison or even made to suffer the extreme penalty of law. Secondly, it should never be lost sight of that very often crimes are committed as the results of environmental conditions and circumstances. No scientist will have either the time or the inclination to undertake any metaphysical investigation of crime. Doctrinaire theories and academic discussions are all waste and weariness of flesh. In the concluding sections of his work, H. T. F. Rhodes has sketched the Russian system of employing criminals in constructive work. "Forests were cleared, swamps were drained, ways were blasted through rock, the course of rivers was diverted." All this was accomplished by persons who had been convicted of criminal offences. The Canal joining Leningrad with the White Sea was constructed by convicts (p. 261).

Quite apart from superficial diagnosis and superficial remedies, the problem of crime and the criminal is basically psychological and philosophical. There is no escape from a certain amount of metaphysics and philosophy! Do the criminals elect out of their own freewill to embark on a calculated career of crime simply for the cruel pleasure of it irrespective of other considerations? Or, money and wealth being foundational factors of society, are crimes committed by some simply because, they are unable to get enough wealth by other pursuits? The *Gita* raises the question in a pointed manner. *"Atha kena prayuktoyam papam charati poorushah Anicchannapi varshneya baladiva niyojitah."* Why does a person commit sin? Why even against his own liking as if driven and goaded by extraneous agent or agents? The Lord answers that ultimately all sins, all crimes are due to psychological motives. *"Kama esha krodha esha rajogunasamudbhava."* *Kama* or desire, and *Krodha* or ire are responsible for all sin and for all crime. Even the most healthy person has within his body the germs of destruction! That is the law of life or law of Nature. In that way, even the best and most efficiently organized social order contains within itself criminals.

Professional politicians and legislators will find the volume of H. T. F. Rhodes most stimulating and suggestive. The criminal must be given a chance to turn a new leaf. One is bound to come across confirmed criminals of habitual anti-social activities. It is indeed most difficult to deal with hardened criminals, but, even the most hardened criminal is a human personality. Legislators should not lose sight of this fact. H. T. F. Rhodes has laid under contribution practically the entire range of relevant literature on crime and criminology, and, I heartily commend his voume to all interested in the problems of crime, criminology, and prison-reform.

R. NAGA RAJA SARMA.

PLEISTOCENE GEOLOGY OF INDIA

BY

D. N. WADIA

NO geological system in India has a fuller or more varied development than the Pleistocene, representing every aspect of the last chapter of the earth's geological history, geophysical, biological, as well as meteorological. It covers, along with the Archæan rock-systems recording the first pages of earth-history, more than three-fourths the extent of India, the remaining twelve geological systems occupying barely one-fourth the land surface of the country. With over 250,000 square miles of the North Indian plains covered under the river-deposits of this age up to a depth of several thousands of feet, fringed in their northernmost edge by a belt composed of the uplifted bottom of this alluvium—the Siwalik foothills—there are ample materials for a thorough study of the period of geological history immediately preceding the present age—the age which brought Man for the first time on the stage of the earth. To this material has to be added the long stretches of contemporaneous Ice Age deposits in the middle and higher Himalayas, and lacustrine, littoral, lateritic and sub-aerial accumulations, bearing traces of the life of the time in other parts of the country. Pleistocene and Subrecent ossiferous gravels, over 3,000 feet deep, have been observed in an alluvial basin in the Upper Sutlej in Hundes and doubtless there are a few other sites, hitherto unknown, of equally promising nature. But, so far these widespread records have remained but partly investigated by the geologists of the country and are awaiting more spacious times and a largely expanded corps of geologists, both official and amateur, for their fuller study. The geologists of the Geological Survey of India, in their preoccupations with the more insistent duty of working out the older formations, capable of yielding results of economic, mineralogical and palæontological value, have felt compelled to put off the detailed examination of this latest rock-formation, which though full of interest, has but an academic interest for the most part and is of no direct use in solving the structural and stratigraphic problems. The present writer well remembers the temptation of spending more time in the detailed mapping of the glacial, lacustrine, and sub-aerial surface deposits of the North-Western Punjab and Kashmir, a temptation which could only have been indulged in at the sacrifice of more urgent basic studies and which was therefore rightly held in check by the senior members of the Party. Pre-history and Archæology have taken a few strides in this country during the last few years, but the dream of the Indian palæontologist that the widely dispersed Upper Siwalik outcrops and synchronous deposits, such as the older river-terraces, gravels, loess, etc., may some day yield the remains of early Pleistocene man —a sivanthropus, has yet remained unrealised.

Geologists, geographers and anthropologists in India must be grateful to the sponsors of the De Terra expedition sent out to India in 1935 for the specific purpose of unravelling Pleistocene history of Stone Age man in India and of studying the Pleistocene Ice-Age cycle in Kashmir. The expedition was organised under the joint auspices of the Carnegie Institution of Washington, Yale University, Cambridge University, and the American Philosophical Society and was under the direction of Dr. Hellmut de Terra, in association with T. T. Paterson and P. Teilhard de Chardin. In a sumptuous volume lately published,* of 354 pages, beautifully illustrated by 56 full-page plates and numerous line drawings, the results of the work carried out are given to the scientific public. The authors have dealt with the large amount of the materials collected (with the help of three able Indian collaborators, Messrs. Sen, Aiyengar and Krishnaswami) and the record of investigations during the ten months of actual field work in India with fulness and lucidity. The major part of the volume, 252 pages, is given to a discussion of the various Ice-Age deposits, their classification and correlation at different centres in South-Western Kashmir. This section contains a descriptive account of the prominent glacial features of large areas of Kashmir territories from the

* *Studies on the Ice-Age in India and Associated Human Cultures.* By H. de Terra and T. T. Paterson. (Carnegie Institution of Washington), 1939. Pp. 354 + Plates 54.

Ladak and the Upper Indus Valley to the water-shed ranges of the Sind and Lidar, the hill-State of Poonch and the Pir Panjal range, that picturesque and extremely well-defined range in the middle Himalayas, which, besides presenting most interesting tectonic problems, offers a wide scope for further detailed glaciological studies. De Terra postulates four distinct glaciations in Kashmir during the Pleistocene, separated by three interglacial stages, of varying intensity and duration, with at least one prominent post-glacial Ice-advance. In this, he more or less upholds the views of Dainelli (the results of whose work in the Upper Indus region were published in 1922 and 1935), though he does not accept Dainelli's dating of the major events in the glacial cycle. De Terra correlates the first two glacial periods with the three Upper Siwalik stages, Tatrot, Pinjor and Boulder-Conglomerate, and with the Lower Karewas of the Jhelum basin, while the two later Ice-advances he considers contemporaneous with the four prominent river-terraces of the major Kashmir valleys and with the Upper Karewas. In describing this glacial sequence, the four distinct advances and retreats of ice, a vivid picture is presented of the great Karewa Lake of Kashmir which filled almost the whole of the Upper Jhelum basin and remained intermittently in existence from the early Pleistocene to the end of the second interglacial and whose disturbed stratified deposits of clays, marls and moraines bear witness to the momentous movements of uplift of the Western Himalayas, to the extent of several thousand feet, during the early and middle Pleistocene. A detailed account of the petrology of the Karewa sediment, their climatic and genetic significance is given by P. D. Krynine. The microscope has revealed a profusion of diatoms in some clays interbedded with lignite layers of Lower Karewas, while pollen of several genera have been found in the silts. To the already long list of dicotyledonous plants of modern aspect hitherto known several new forms have been added. Elephant, deer, fish and fresh-water molluscs, mostly belonging to living species, and some human artefacts are the principal animal fossils discovered by the party from the Karewas.

Sixty pages are devoted to the Pleistocene geology and palæolithic culture of North Western Punjab (Potwar and Salt Range mountains) where an interesting suite of Chelleo-Acheulian implements (in which the pebble-tools and cores preponderate) have been discovered, including many from a still lower horizon that is taken to be the top-beds of the Boulder-conglomerate stage of the Upper Siwaliks. Paterson discusses the archæology of these finds and classifies the cultures as *early Soan, late Soan, Chauntra industry*, etc. The classification and stratigraphy of the Siwalik sequence of Potwar are treated at some length, the correlation of the various series and stages adopted by the authors being in some respects at variance with that adopted by the Geological Survey of India, especially in the definition of the Pliocene-Pleistocene boundary, the age of the Dhok Pathans and the age of the topmost Siwalik zone.

The Pleistocene stratigraphy of the older alluvium of the Narbada valley and of the Madras coastal plain and their palæolithic industries are described in two brief chapters. The relations of the interesting new implements, discovered by members of the expedition from these southern areas, with the stages of the Soan sequence as worked out in the Punjab, are discussed.

For a ten months' programme of intensive field-work in a region of such complexity the results obtained by the expedition form an impressive record and the leader and his collaborators are to be congratulated on such a successful outcome of the work. Of course, it would be rash for anyone to say that the classification of the glacial record of Kashmir, or that the proposed correlation of the various glacial and interglacial stages, *inter se* and with the terrace system of the Jhelum on the one hand and with the Upper Siwalik stages on the other, is finally accomplished. No such finality can be claimed for a glacial system displaying such a complex interrelation of geological agencies, climatic, hydrographic and orogenic, as those which again and again disturbed the course of the glacial cycle in Kashmir and produced a puzzling jumble of deposits lying at widely varying levels. The present writer, for instance, is unable to accept the correlation of the Boulder-conglomerate horizon with the second glaciation as anything more than provisional, or that there is any appreciable proportion of moraine blocks in the coarse bouldery gravel which composes it. It appears to him likely that the considerable body of residual gravels capping this conglomerate at Jammu and Rawalpindi has been

included in the latter. The rather precise affiliations of the various river-terraces to the glacial stages may also on more detailed investigations prove to be hypothetical in several cases. But, as a foundation for future work and as a suggestive guide to it, much has been done to stimulate and help future workers in this field.

In the dating of the Dhok Pathans and the Upper Siwalik stages one stage forward and the placing of the Mid Siwalik-Upper Siwalik boundary so high up as the junction-plain between Pliocene and the Pleistocene, de Terra departs from the work of Pilgrim, Cotter and the present writer with, it appears, but inadequate evidence. A great deal of emphasis is placed on certain minor erosional unconformities and conglomeratic beds in the Dhok Pathan, Tatrot and Pinjor zones.

Recent work in the area between the Salt Range mountains and the foot of the Hazara-Kashmir Himalayas—a terrain of most copious sedimentation—reveals except for a few minor and local breaks, no unconformity or palæontological gap of any significance between the late Tertiary and Pleistocene. On the contrary, the voluminous series of fresh-water and subaerial deposits (17,000 feet thick) bridges the gap, *on the whole* uninterruptedly, from Middle Miocene to Lower Pleistocene. A number of small local breaks and discordances, due to contemporaneous erosion, do occur in the sequence and make a striking show, as indeed one would expect in a zone of active aggradation by the vigorous, repeatedly rejuvenating streams descending from a tract of recent elevation. The Middle Siwalik, broadly speaking, grades off into the Upper Siwalik without any but a few minor breaks which, however, are sporadic and disappear when followed laterally. The main unconformity of the area is post-Upper-Siwalik denoted by an unconformable overlap between the Upper Siwalik and their overlying Sub-Recent river alluvia. But, this too is not a *hiatus* of any regional importance, tending to diminish in the Soan Valley. At least 10,000 feet of sediments intervene between the Dhok Pathan stage (Pontian) of the Upper Middle Siwalik and the Boulder-Conglomerate stage, the topmost stage of the Upper Siwalik in the Soan Valley. From the palæontological work of Pilgrim in this area based on his three decades' research on the fossil bovids, pigs, giraffes and carnivores, (1911–39) generally corroborated by the detailed mapping of G. de P. Cotter in the years 1926–28 and of the present writer during 1921–25, little doubt now remains that the Upper Siwalik, except perhaps in the very topmost part, is pre-glacial and lies astride the Pliocene-Pleistocene interval of Europe. Indeed the Upper Middle Siwalik and Upper Siwaliks, from the Lower Pliocene upwards, have been grouped together into one unit by more than one observer from the difficulty of separating them by a definite geological dividing-line.

The above, however, are points of comparatively minor disagreements. The authors have fully acknowledged the help they have received from the work of the Geological Survey of India and to the existing literature on the subject. To this literature, the present monograph makes a most useful and stimulating addition.

SILT INDICES AND DISCHARGE ELEMENTS FOR REGIME CHANNELS

Silt Indices and Discharge Elements for Regime Channels—An investigation of the Interrelation of Silt Indices and Discharge Elements for some Regime Channels in the Punjab. By Dr. N. K. Bose and Dr. J. K. Malhotra. (Punjab Irrigation Research Institute, Research Publication), 1939, 11, No. 23. Price Rs. 1–10–0 or £ 0–2–5.

SILT plays a very important part in the economy and the design of a canal system.

For seven years hydraulic data and bed silt samples have been collected from a number of regime channel sites in the Punjab. In 1930 Lacey, based on data from different Provinces in India and Egypt, deduced his formulæ $P_w = 2{\cdot}688\ Q^{\frac{1}{2}}$. This formula has been confirmed with a slight variation of the coefficient as a result of certain definite observations made on suitable channels in the Punjab. In 1932, re-examination of the relation of silt to Hydraulic Data, based on silt particle size, was started and this memoir gives the results of the research.

A channel carries silt in two different ways—the floating silt below 0·05 mm. in diameter and the rolling silt above this size, a silt that hops and rolls and moves slowly as sand dunes on the bed of the canal. This rolling silt really forms the so-called boundary layer of Prandtl between the solid bed of the canal and its flowing fluid. The authors think that the distribution of silt in this layer will really determine the energy distributed in the general body of the fluid and hence determine the selection and slope of the channel.

To give a numerical idea of the various properties of the bed-silt samples "weighted mean-size" and the "standard-deviation" have been used as indices, the former indicates the dominant size, the latter the distribution of other sizes about this size.

The authors found the diameter-size distribution curves to indicate, to a very remarkable degree, the life-history of a channel. Silt samples with almost the same average diameter have very different distributions. These curves for the same channel show a swing of the peak from the left to the right and then from the right to the left, this swing becoming the more pronounced the bigger the channel. The swing seems to be a characteristic of the turbulence of the channel and a study of the curves indicates the probable stability of the channel. The distribution curves of the bed are broadly classified into 3 groups:—(1) Left Hand Type (with peak to the left), (2) Middle Type (no peak) and (3) Right Hand Type (with peak to the right).

Turbulence churns up the whole of the fluid equalising the velocities of the water from one boundary to the other and the middle type of the silt curves indicates a stage in the canal when the churning action is taking place and silts of all grades are made to move on the bed of the canal. During this stage no heavy scouring or setting takes place in the canal. This type has been generally associated with the most stable of channels and when a channel goes off regime these curves become rarer and rarer. Observation also shows that canals in which all the three types occur frequently with no predominance of any one type, will be most stable.

The following three empirical relationships are put forward for the design of a channel, based on the discharge and the silt it has to carry:

$$S \times 10^3 = 2{\cdot}09 \frac{m^{1{\cdot}86}}{Q^{1{\cdot}21}} \quad .. \quad (1)$$

$$\lambda = \frac{R}{P} = \frac{1}{6{\cdot}25} \frac{S^{\frac{1}{2}}}{m} \quad .. \quad .. \quad (2)$$

$$P = 2{\cdot}8\ Q^{\frac{1}{2}} \quad .. \quad .. \quad .. \quad (3)$$

where S is the slope of the water surface measured in feet per thousand feet, Q, the full supply discharge in cusecs, m the average diameter in mm. of the bed silt, R, the hydraulic mean radius and P, the wetted perimeter.

The only quantity difficult to fix is m. It has been found that there is an annual variation in the values of m of any particular channel and this is due to variation of temperature of the water in the channel leading to a corresponding variation in the viscosity of water. This change of viscosity in the boundary layer makes silt particles of the same effective size with respect to diameter fall faster in summer than in winter. Assuming the upward lift of the turbulent eddies moving along the boundary layer more or less to be the same throughout the year, the silt that will be found in motion in the boundary layer will be smaller in size in summer than in winter. The value of m has to be reduced to that of 20° C., the average temperature for the whole year for the whole of the Punjab.

Within the limits of the silt indices calculated for the observed channels it has been found that $P = 2{\cdot}8\ Q^{\frac{1}{2}}$ and $R = 0{\cdot}47\ Q^{\frac{1}{2}}$ have a very high correlation. It hence appears that within the limits of silt and slope met with in the observed channels, the hydraulic mean radius depends more on the discharge than on other elements.

To determine the value of m at any point of a system knowing the value of m in the river at the point from where the canal takes off it is proposed to commence an investigation of a whole canal system and carry out laboratory experiments on the silt-selective capacity of different outlets and heads. It is also proposed to study the effect of moving silt on the regime of a channel supported by laboratory observations on a tilting flume to correlate different grades of turbulence with bed silt movement.

The results of these investigations will be awaited with interest.

C. GOPALAKRISHNAN.

THE DIAMAGNETISM OF THE MOBILE ELECTRONS IN AROMATIC MOLECULES*

CONSIDERABLE progress has been made during recent years in our understanding of the structures of aromatic molecules and in particular of benzene. From the application of quantum mechanics, and detailed investigations on the Raman and infra-red spectra of benzene and its deutero-isomers, it is found that one electron in each carbon atom in the ring is mobile and is more or less free to migrate from atom to atom over the whole of the ring. These mobile electrons have interesting magnetic properties, not dissimilar to that of free electrons in metals.

Many properties of metals are explained satisfactorily on the assumption that a certain number of electrons get detached from their atoms and are free to migrate from atom to atom throughout the metal. These electrons can be regarded as forming a free-electron gas but their spin-susceptibility is limited by the degeneracy prevailing at all ordinary temperatures, and is given by $k_p = 3/2 \frac{n\mu^2}{kT_0}$, where T_0 the degeneracy temperature $= \frac{h^2}{8mk}\left(\frac{3n}{\pi}\right)^{2/3}$. Contrary to the classical theory, the free-electron gas can also exhibit a diamagnetism, as shown by Landau, of value equal to $\frac{-n\mu^2}{2kT_0}$ (when $T \ll T_0$). It is difficult to verify this Landau's diamagnetism particularly on account of the predominant paramagnetism with which it is normally associated. In the case of graphite, however, conditions are favourable for such a verification, as here the spin moments of the electrons are paired to give zero paramagnetism and the restriction of motion of electrons practically to the basal plane has effectively lowered the degeneracy temperature to 520° K. Experimental values beautifully confirm Landau's theory with one electron per carbon atom free to move about in the basal plane.

The occurrence of such mobile electrons is characteristic of all aromatic molecules and is an essential feature of the quantum mechanical theories of the structures of these molecules. Their mobility is a necessary consequence of the uncertainty principle according to which the larger the region assigned to these electrons, the smaller would be their kinetic energy. The actual structure of the aromatic rings is that obtained by "resonance" between a number of canonical structures. An important consequence of the freedom of the mobile electrons to move from atom to atom over whole rings, as in benzene, naphthalene, etc., is the abnormal diamagnetism perpendicular to the plane of the ring.

When these magnetically anisotropic molecules are arranged in a regular manner as in a crystal, the crystal as a whole will naturally exhibit an anisotropy, whose magnitude will depend upon the anisotropy of the individual molecules and on their orientations relative to one another. Where the magnetic constants of the molecule are already known, magnetic studies on the whole crystal enable us in favourable cases to obtain useful information about the orientations of the molecules in the crystal lattice. Conversely, when molecular orientations are already known from detailed X-ray studies, the principal magnetic constants of the molecules can be calculated with high accuracy. Such calculations for a large number of aromatic molecules show that the diamagnetic contribution due to the mobile electrons is roughly proportional to the number of benzene rings in the molecule. Other conjugated molecules with plane ring structures such as cyanuric trichloride and phthalocyanines also show diamagnetic anisotropy, and sometimes, as in the case of phthalocyanines with a 16-membered ring, the susceptibility normal to the plane is 7 times that for the direction in the plane.

The restriction of the freedom of migration of the mobile electrons in these molecules to the molecular plane is also evidenced by the striking directional variations in some of the optical properties of these molecules. Thus in naphthalene, chrysene, etc., it is only the component of the electric vector of the incident light wave in the molecular plane which is absorbed by the molecule, whereas the component along the normal to the plane is not absorbed.

Pauling has evaluated, adopting a semi-classical theory, the effective size of orbits which the mobile electrons will describe in the plane of the molecule under the influence of a magnetic field perpendicular to the plane and thence the diamagnetic susceptibility. On this view any temperature variation in susceptibility such as is markedly observed in graphite, cannot be explained. This temperature coefficient can however be accounted for quantitatively on the quantum mechanical theory, as due to the change in the energy distribution of the electrons with temperature. According to a theory more recently developed by London, other features such as that the anisotropy of diphenyl is larger than twice that of benzene, are also accounted for.

M. A. G.

* Summary of Presidential Address,—by Prof. K. S. Krishnan, D.Sc. Physics Section—Indian Science Congress, Madras, 1940.

THE RÔLE OF CHEMISTRY IN FORESTRY*

DR. KRISHNA'S broad survey of the rôle of Chemistry in Forestry was designed to focus attention on the "Vast forest wealth of India which has, hitherto, been only partially utilised for the industrial development of the country" and "the part a chemist plays in developing and exploiting" this wealth. Soil factors and plant nutrition present problems to the chemist ranging from soil productivity to plant hormones. The chemist is also of help to the botanist in identifying doubted species; a striking practical application of such assistance was provided in the cultivation of *Artimesia maritima*. In Forest conservation and protection, the fight against the insect pests which cause untold damage is only possible with the co-operation of the chemist, who has placed in the hands of the entomologist several insecticides, both natural and synthetic. But, it is in the field of utilisation that the rôle of Chemistry is far more varied and extended than in either sylviculture or conservation. Wood is the most important Forest produce. The chief limitation of timber is decay and scientific research has been specially directed to remove this defect. The chemist has made great contributions to the solution of this problem, although the ideal timber preservative has yet to be discovered. Again, the technique of plywood and laminated core construction is entirely dependent on satisfactory glues being evolved by the synthetic chemist.

While the contributions of the chemist in the utilisation of timber have been so diverse, his rôle in the economic utilisation of "Minor Forest Produce" covers a still wider field. The use of the terminology "Minor Forest Produce" is rather unfortunate, tending as it does, to obscure the very great value—both actual and potential—of this group of the forest harvest. "Minor Forest Produce" is at present the cinderella in the realm of forest utilisation. On their own merit, M.F.P. deserve greater care and attention. The objection that the collection of M.F.P. is expensive and undependable, is not insurmountable. There is ample material to be worked up on a "cottage industry" scale. For the proper utilisation of M.F.P., the chemist has to solve the problems on the best and most economical method of extraction of the active principles, the study of the chemistry and constitution of the constituents, questions of drying and storage and many other related problems. The utilisation of bamboos and grasses for paper pulp, the distillation of turpentine from *Pinus longifolia*, of sandalwood oil and to a smaller extent of other essential oils, have been rendered possible by the chemists' activity. Apart from extending this activity, even to retain existing markets requires continuous chemical research to better methods, improved yields, grades and maintain consistent quality. Even what appear at present to be monopolies are not immune to the onslaught of competitors as many Indian products bear testimony. There are large numbers of other raw materials for the production of essential oils, and also, oil-bearing seeds which have yet to be investigated. The same remark applies to tanning materials which add their quota to forest revenue.

India abounds in innumerable medicinal plants and herbs. Most of these drugs, though used from time immemorial in the indigenous systems of medicine, do not find sufficient recognition because correct knowledge regarding their potency, active constituents and pharmacology is still lacking. Of the few that find recognition in the official pharmacœpeas, the wasteful and uneconomic method of exporting the raw material itself prevails. India possesses a variety of soils and climates and, therefore, could easily cultivate and acclimatise a variety of herbs and plants of economic value. Cinchona has thus been introduced into India. Pyrethrum and Derris provide other examples, the former having been introduced as an exotic to Kenya, where it has acclimatised itself. In general, the condition of the drug trade in India is unsatisfactory. Some of the difficulties in the way of manufacturing drugs in India can only be remedied, if a regular supply of genuine raw materials of proper quality is assured. Special organisations have been set up for this purpose in many European countries and valuable services have been rendered by such organisations in stimulating cultivation and improving the quality of drugs and the general standard of trade in their respective countries. It would perhaps be advantageous if such an association were to be formed in India also. It is not too early to begin.

---

* Summary of Presidential Address,—by Dr. S. Krishna, Chemistry Section—Indian Science Congress, Madras, 1940.

THE CRETACEOUS-EOCENE BOUNDARY*

"THE study of the Cretaceous-Eocene boundary is a live problem of world-wide interest, and it is likely that studies in India will be of fundamental importance in the elucidation of this problem. We have several areas which offer a promising field for this investigation, and a good beginning has already been made. It is up to us now to pursue these investigations further, and do the best that we can in this fruitful and fascinating field of research"—thus concluded Prof. L. Rama Rao in his Presidential Address to the Geology Section on "Recent Advances in our knowledge of the Upper Cretaceous and Lower Eocene beds of India, with special reference to the problem of the Cretaceous-Eocene boundary."

Reference is made to the recent advances in our knowledge of that great volcanic formation known as the Deccan Trap, with special reference to the age of this formation, and points out how the recent discoveries of fossils in the infra- and inter-trappean beds of different areas clearly indicate at least a Lower Eocene age.

The rich algal flora discovered in the Upper Cretaceous beds of Trichinopoly, Pondicherry and Rajahmundry areas, throws new light on the nature, origin and distribution of Upper Cretaceous and Lower Tertiary algæ in general, and a detailed study of this flora will no doubt lead to results of great value both to the stratigraphical geologist and the palæobotanist. Of particular interest and great importance in the study of the Cretaceous-Eocene transition in South India, is the recent discovery of an Eocene bed in the Pondicherry area, which was hitherto considered as composed exclusively of Cretaceous rocks. It is not unlikely that this will lead to similar finds in the other 'Cretaceous areas' along the east coast of Southern India.

After alluding to the Cretaceous-Eocene transition and associated palæogeographical conditions in India and adjacent countries, based on the recent work done on these rocks in India, Africa, Australia and New Zealand, Prof. Rama Rao has put forward some general considerations of great importance in the proper interpretation of the Cretaceous-Eocene boundary, not only in India but also in the adjacent continents.

* Summary of Presidental Address,—by Mr. L. Rama Rao. Geology Section—Indian Science Congress, Madras, 1940.

THE PLACE OF GEOGRAPHY IN NATIONAL PLANNING*

IN any scheme of planning, the physiography of the country is to be known first, then its soil conditions and vegetation coverings. The geographer is competent to furnish ready information on these points. If all the information regarding the existing conditions be not readily available, a geographical survey of these needs be conducted.

No country in the world needs this kind of survey more than India. Take for instance Bengal, where lands are deteriorating, soils fast losing their powers of productivity, rivers failing to fulfil their task of land-building, marshes and lakes increasing in area at the cost of good arable lands, and a large number of population subsisting on insufficient diet in a pitiable environment. Other provinces are no better, though their problems may be slightly different. For a proper solution of these it is maintained that a stock-taking on a provincial basis is needed in the first instance, that is to say, a geographical survey is to be conducted with a view to studying the economic and agricultural possibilities of the provinces, and furnishing materials on which an edifice of future prosperous India could be built up.

As we proceed from Assam to the Punjab through Bengal, Bihar and the United Provinces, we find that the proportion of irrigated area to the total sown area increases steadily following the decrease of rainfall, being maximum in Sind, where artificial irrigation is practised very extensively. The proportion of irrigated land also increases as we proceed from Assam to Travancore through Bengal, Orissa and Madras. Travancore is one of the rainiest areas of India, and still the area of irrigated land is about one-half of the total area under the plough.

The area of land kept fallow is definitely higher in the lower Ganjetic valley (Bengal) than in the upper Gangetic (U.P.) and the upper Indus (Punjab) valleys. In the lower Indus valley (Sind) the proportion of fallow land to the total sown area is about the same as in the lower Gangetic valley (Bengal). In the zone of maximum cultivation, Bombay and Hyderabad have fairly large fallow lands, but Baroda has none.

Let us now have a look at the population map of the Gangetic plain, the most densely populated region of India. It is clear that the population increases considerably as we proceed towards the plain either from the northern mountainous region or from the southern plateau region. If we carefully examine the map, we find that there is some order in the variation of population in the Gangetic valley, that is to say, area of dense population alternates with area of relatively sparse population. This illustrates the theory of Vidal de la Blache that population does not spread out evenly like oil, but spreads out in swarms like bees.

By synthesising the findings of other branches of knowledge, geography presents a complete picture of the country, which may then pass on to the hands of the

* Summary of Presidential Address,—by Prof. Shibaprasad Chatterjee. Geography and Geodesy Section—Indian Science Congress, Madras, 1940.

planner for re-touching. The rôle of the economist in national planning is not underestimated, but what is claimed by geography is that the geographer can certainly help the economist to keep his feet on the earth. To materialize a scheme of national planning in India, which is the home of one-fifth of the population of the world and where cultivable land per head of population is less than that of other agricultural countries, the starting of an all-India organization for conducting the Geographical Survey of the country, more or less, on the lines of the existing Geological Survey, will be a distinct step forward.

CENTENARIES

Poisson, Simeon Denis (1781–1840)

SIMEON DENIS POISSON, a French mathematician, was born at Pithiviers in the district of Loiret, June 21, 1781. He has recorded an interesting anecdote about his infancy: The infant was put out to nurse. One day his father went to visit his baby. Finding that the nurse had gone to the fields he impatiently broke into the cottage and there saw, with painful astonishment, his darling suspended by a small cord to a nail fixed in the wall to prevent his being injured by the animals in the house. Poisson added, "A gymnastic effort carried me incessantly from one side of the vertical to the other; and it was thus, in my tenderest infancy, that I made by prelude to those studies on the pendulum that were to occupy so much of my maturer age."

After elementary education, he was sent to learn surgery from an uncle of his. "Once my uncle sent me", he says, "to put a blister on the arm of a child; the next day when I presented myself to remove the apparatus, I found the child dead; this event, very common they say, made the most profound impression on me; and I declared at once that I would never be either physician or surgeon. Nothing could shake my resolution, and they sent me back to Pithiviers." There he happened to chance upon a copy of the *Journal de l'Ecole Polytechnique* received by his father and began to solve, unaided, the problems proposed there. This discovered his mathematical propensity. He joined the Polytechnic School at Paris in 1798. His professors discovered his genius and exempted him from the drudgery of the curriculum. This released his energy for creative work and in 1800, he published two memoirs, one on Bezout's method of elimination, the other on the number of integrals of an equation of finite differences. At the instance of Legendre, the latter was published in the *Recueil des savants etrangers*.

This brought him immediately to the notice of Lagrange and Laplace. After the completion of his course, he was appointed repetiteur of his school. In 1802 he was made additional professor and succeeded Fourier as professor in 1806. The following are the posts he held thereafter: astronomer to the Bureau of Longitudes (1808); professor of mechanics (1809); member of the Institute (1812); councillor of the university (1820); and geometer to the Bureau of Longitudes in succession to Laplace (1827). In spite of the stormy days in which he lived he was left undisturbed in his academic career. That is because, Napoleon was wise enough to see that nothing was to be gained by persecuting the harmless academician whose fame he doubtless regarded like that of the other savants of France as an appanage to his own glory. What a contrast to what obtains to-day under the urge of racial and communal hatred!

Poisson's outstanding contribution to pure mathematics is the series of memoirs on definite integrals. His discussion of the Fourier's series paved the way for the classical researches of Dirichlet and Riemann. His memoirs on the calculus of variation and the theory of probability are also worth mentioning. His range in applied mathematics was very wide; electricity and magnetism, heat, gases, capillary attraction and gravitation. In planetory theory he carried forward Lagrange's work on the stability of orbits to the second degree of approximation. Lagrange thought so highly of this memoir that he made a copy of it with his own hand in spite of his old age (1809). What is more significant, it stimulated old Lagrange to write one of the greatest of his memoirs on the same subject. Poisson's well-known correction of Laplace's differential equation for the potential came out in 1813.

On the whole, Poisson wrote about 300 papers in addition to the five treatises most of which were intended to form part of a great work on mathematical physics, which he did not live to complete.

Poisson died, April 25, 1840.

S. R. RANGANATHAN.

SCIENCE NOTES AND NEWS

Alcohol Production in Milk.—Only one instance of a yeast obtaining access into milk and causing alcoholic fermentation has been recorded in India. A strain resembling *Torula lactis* was isolated and studied by the author in 1926 from a sample of spoilt milk in Karnal (*Bull.* No. 183, *Agl. Research Institute*, Pusa). The organism was propagated over a long period, but ultimately it died off.

Recently, in the course of an investigation on the bacterial flora of *dahi* from the Bangalore District, some *dahi* was left overnight at room temperature (76° F.) in a glass-stoppered bottle. The stopper was found to be blown off the next morning owing to the production of carbon dioxide and the product had a pronounced alcoholic odour.

A plate culture on brom-cresol purple lactose agar from the sample of *dahi* of the previous day, showed white colonies of a butyrous consistency, which appeared to be yeast cells. The colonies changed the colour of the agar from purple to yellow owing to acid production. The organism was isolated in pure culture and when inoculated into sterile milk and incubated at 30° C. for four days, it produced about 2 per cent. of alcohol without curdling the milk. The organism is being studied as regards its fermentative reactions and morphological characteristics.

C. S. RAMAYYAR.

* * *

Sulphur and Thionyl Iodides.—The existence of sulphur and thionyl iodides has been the subject of much controversy. The recent work of M. R. A. Rao (*Proc. Ind. Acad. Sci.*, 1940, 11, 162) has definitely established that these compounds are produced when dilute solutions of the corresponding chlorides in carbon tetrachloride are treated with dry potassium iodide powder under suitable conditions. A solution of sulphur iodide in carbon tetrachloride is yellow in colour. The compound decomposes rapidly in presence of light. The decomposition is favoured by a rise in temperature. Investigations on the kinetics of decomposition indicate that the velocity of decomposition increases rapidly with an increase in the concentration of the sulphur iodide. The reaction of sulphur iodide with aqueous sodium hydroxide has been investigated quantitatively and is found to be similar to that of sulphur chloride with the alkali.

Thionyl iodide is found to be much more unstable than sulphur iodide. Even during the preparation, a portion of the iodide decomposes into sulphur, sulphur dioxide and iodine according to the equation $2\ SOI_2 \rightarrow S + SO_2 + 2\ I_2$. The hydrolysis of thionyl iodide in presence of alkali has been studied and a quantitative interpretation of the products of hydrolysis given. Thionyl iodide is highly unstable in presence of light. It is more stable at lower temperatures. The absorption spectra of sulphur and thionyl iodides have been investigated and the results are in conformity with the analytical data. The method adopted to prepare the sulphur and thionyl iodides, seems to be general in scope and applicable to the preparation of many such unstable iodides.

* * *

Cytogenetical Analysis of the Chromosomes in the Pig.—A clear account of the structure and behaviour of the chromosomes in the pig is given by F. A. E. Crew and P. C. Koller (*Proc. Roy. Soc. Edin.*, 1939, 59, 163). The diploid number is 38 and the two sex chromosomes are unequal, the *Y* being shorter and about 2/3 the length of *X*. It is possible that the centromere in the sexchromosomes is situated between the pairing and differential segments. Regarding the chiasmata it has been noticed that their number does not undergo any change or reduction as meiosis advances, there being no terminalisation. In the five large bivalents the chiasma formation is localised and it has been observed that recombinations of genes in these bivalents are also limited. The case of an individual where a pair of chromosomes was heterozygous for an inversion is also reported.

* * *

Natural History of Lake Vattern.—In a recent number of the *Acta Phytogeographica Suecica* (vol. XI, 1939), Nils Stalberg gives a complete account of Lake Vattern, with special reference to its natural history and vegetation. The Report was intended as a guide to the Excursions of the Ninth International Congress of Limnology, and of the Seventh International Botanical Congress which recently met at Sweden, and embodies all the known information about this Lake, including the author's own researches. The Report begins with a description of the geological history and the topography of the Vattern basin and proceeds to give an account of the Hydrography of the Lake in all its aspects. The latter half of the Report deals with the fauna and flora living in this basin—especially the latter of which several vascular plants, many characeæ and numerous epilithic algæ have been figured and described.

* * *

Biological Standardisation of Gas-gangrene Antitoxins.—The recent *Bulletin of the Health Organisation* of the League of Nations is devoted to the subject of standardisation of *gas-gangrene antitoxin* (*perfringens*). The method in vogue, was subjected to criticism by Prof. M. Weinberg of the *Pasteur Institute* of Paris who observed considerable divergences in the titres assigned to perfringens antitoxins when different toxins were used for assays on mice. His conclusion was that it was necessary to employ a standard test toxin in addition to the standard serum. A critical enquiry into the method of standardisation was undertaken at Buenos Aires, Copenhagen and Hampstead institutes. The results obtained are reported in the Bulletin.

The Bulletin also deals with the question of the standardisation of the *gas-gangrene antitoxin (Sordelli)*. Infections due to the gas-gangrene represented by the Sordelli bacillus are frequently met with on the American Continent, although very rare in Europe and the elaboration of an international standard preparation and of an international unit for the corresponding serum are justified.

* * *

Rehabilitation of Adult Prostitutes.—The results of the enquiry into the problem of rehabilitation of adult prostitutes carried out by the *League of Nations*, are presented in a recent volume (*League of Nations Publications IV—Social Questions*, iv, 1939, 4, pp. 157). The rescue work carried out by general welfare institutions has been reviewed. Of the large number of prostitutes rehabilitated by these institutions, very little is known about their later career. In the opinion of most of the workers in this line, rehabilitation succeeds with those women who have practised prostitution for a short time. While some workers think that domestic work is most suitable for the rehabilitated prostitutes, others suggest industrial occupation or factory work as the best. Re-entry into normal life is best achieved through a happy marriage and many reports agree that a high proportion of marriages of former prostitutes proves successful. Judging from the actual volume of success achieved by these agencies in respect of the diminution of prostitution, the League's Committee on Social Questions rightly comes to the conclusion that "there are no facts to warrant the hope that measures of rehabilitation, by themselves will ever greatly diminish the number of prostitutes".

G. S. G.

* * *

Ancient Coins Discovered at Taxila.—Two hoards of punch-marked coins, discovered in Sir John Marshall's excavation on the *Bhir* mound, the oldest of the three successive cities at Taxila dating back to the sixth century, B.C., have been recently studied by Mr. E. H. C. Walsh, I.C.S. The results of his study have been published in a monograph issued by the ARCHÆOLOGICAL SURVEY OF INDIA. From a study of the weight of the coins, the conclusion is reached that India must have had, from the earliest times, an independent system of weight. The coins furnish a future standard of reference for punch-marked coins, as the coins extend over a longer period and contain more varieties and are in every respect more complete than the British Museum specimens. Certain minute coins less than 1/5" in diameter and weighing about 2½ grains, are the most unique amongst the finds.

* * *

Studies on Indian Coals.—Important researches on Indian coals have been conducted at the *Indian School of Mines*, Dhanbad. These include studies on washability and coking, occurrence of sulphur in Indian coals and chemical composition of Indian coal ashes. X-ray studies were also made of vitrain in Indian coals with special reference to coals in the Jharia Coalfield and of the structure of pyrene. In addition, a number of original scientific papers have been published.

* * *

Botanical Survey of India.—The annual report for the year 1938–39 records the efforts made throughout the year to secure specimens of medicinal plant products, plant materials used as vegetable insecticides, etc. Commercial timbers, samples of hand-made and machine-made paper of different qualities have also received attention; in this connection one is tempted to ask if an activity in this direction may not be considered as a duplication of the work carried out by the Forest Research Institute at Dehra Dun.

Systematic botanists have been assisted by the survey and the Herbarium at the Royal Botanic Gardens, has been strengthened by the addition of some 2,000 plants. Special attention should be invited to the investigations on the poisonous plants of India conducted by Col. Chopra and his collaborators.

* * *

University of Bombay.—*Department of Chemical Technology*: The Prospectus and Research Report for 1938–39 of this Department indicate clearly the two important functions which this recently started university department is fulfilling. Advanced training and facilities for research are provided in Textile Chemistry and Chemical Engineering to suitable candidates in order to equip them to occupy responsible positions in industry. The department also acts as a centre of research and analytical laboratory for the benefit of the industries of the Bombay Presidency and is endeavouring to co-operate with mills and industrial concerns in carrying out industrial research on their behalf or investigating any technical problems that may arise in the course of their work. Further, routine chemical analyses of every kind are undertaken on behalf of industry in general. The Department also functions in particular as a test house for the mill-owners of Bombay and Ahmedabad.

The research report has been conveniently divided into four sections dealing respectively with work published, papers forwarded for publication, work completed and research in progress. We are glad to note that a good beginning has been made in the Department by way of subsidised research. Thus "A fellowship of Rs. 100 per month to the University, has been endowed by Messrs. Das & Co., Bombay, for one year in the first instance, for the purpose of investigating certain industrial problems in which they are interested". Such schemes of industrial fellowships at once prove the worth of this progressive department and also its potentialities for the future industrial progress of India.

* * *

Detection of Carbon Monoxide.—The Department of Scientific and Industrial Research has issued a further leaflet in the series "Methods for the Detection of Toxic Gases in Industry" dealing with carbon monoxide. (Leaflet No. 7, published by H. M. Stationery Office, price 1s.

6d. net.) Among the industrial situations in which this gas may be encountered in dangerous concentrations are blast furnaces, brick kilns, chemical works, foundries, gas works, coke ovens and lime kilns. Carbon monoxide is colourless and odourless and is, therefore, most insidious in its action. The first symptoms of poisoning are, shortness of breath and palpitation on exertion, accompanied by headache which increases in severity. With increasing intoxication the judgment becomes disturbed and the affected person may not realise his danger. An atmosphere in which a concentration as low as 1 part in 2,000 is present, may prove fatal in about one hour to a person engaged in an active occupation. On the other hand concentrations below 1 in 10,000 may be regarded as relatively harmless for all practical purposes.

The standard method developed for the detection of carbon monoxide in industry consists in drawing samples of the atmosphere under test through a known area of test paper, treated with palladium chloride, at a slow and constant rate, by means of a 5-litre aspirator. This method enables interfering gases to be removed by allowing the sample first to pass through a tube of activated charcoal. Sampling is continued until a stain is obtained on the test paper which compares with the standard colour chart; the concentration present is then determined by comparing the time required to reach the necessary colour, with the times given on the chart. In this way concentrations of 1 part in 500 can be detected in less than two minutes, and of 1 part in 10,000 in half-an-hour. Full instructions for carrying out the test, and the colour chart, are contained in the leaflet.

* * *

Nature announces that **Mr. H. G. Champion, I.F.S.**, has been appointed Professor of Forestry, University of Oxford, in succession to the late Prof. R. S. Troup. Mr. Champion who joined the Indian Forest Service in 1915, has made several notable contributions to sylvicultural research in India. His "Sylvicultural Research Manual for India" which appeared in two parts —the experimental manual and the statistical code—is perhaps the best known among his works.

* * *

Under the joint auspices of the *Association of Technologists*, Bangalore, *The Indian Academy of Sciences*, *The Indian Chemical Society* (Madras Branch), *The Institute of Chemistry* of Great Britain & Ireland, *The Society of Biological Chemists*, India, *The South Indian Science Association*, Bangalore and *The Technical Association*, Bhadravati, a session of scientific meetings was organised during the Easter Week, March 22nd to 26th. In his Presidential Address, **Sir C. V. Raman** dealt with the results of a new series of investigations on the diffraction of X-rays by crystals, carried out at the Indian Institute of Science by himself and Dr. P. Nilakantan. A new type of X-ray reflection has been observed, the discovery of which opens out a fresh approach to the problems of the solid state. A symposium on "Technique of High Temperatures in Industries" was held when Dr. J. C. Ghosh described some successful attempts at improving the calorific value of water gas. Mr. B. Visvanath (Managing Director, The Iron and Steel Works, Bhadravati) talked on the manufacture of refractories and heat insulators, Dr. M. A. Govinda Rau on the economics of high temperature production, Mr. Junnarkar on the potentialities for using electric power for high temperature furnaces, and Messrs. G. B. Shankar and K. S. G. Doss on methods of control and measurement of temperatures. Mr. G. P. Ogale of the Mysore Glass and Enamel Works raised interesting questions regarding the economics of furnaces used in glass industry, and Mr. H. N. Ramachandra Rao of the Government Porcelain Factory discussed the features of an electric tunnel kiln for firing hard porcelain, under construction. Several other papers were presented on different aspects of high temperature work in connection with the manufacture of cement, steel and paper.

A number of original papers were presented on physical and biological sciences. Dr. H. J. Bhaba had an important contribution on the fundamental effect of the spin of an electron on the electro-magnetic radiation. A group of papers on fossil algæ by Prof. Rama Rao and students were highly commended by Prof. B. Sahni who presided on the occasion.

There were three public lectures, one by Dr. Bhaba on "Stellar Chemistry," another by Mr. B. Visvanath on "The Iron and Steel Industry in Mysore" and the third by Sir C. V. Raman on "Glass".

There was a special meeting of the Technologists Associations and an exhibition was organised to bring out the potentialities in the way of manufacture of scientific instruments and industrial plants in the State.

* * *

INDUSTRIAL NOTES

Linseed Fibre Industry in India.—Dr. R. H. Richharia of the *Agricultural Research Institute*, Nagpur, has drawn attention to the possibility of recovering fibre as a by-product from the straw of the linseed plant grown for seed. Experiments conducted in this direction at the *Oil-Seeds Research Laboratory*, Nagpur, financed by the *Imperial Council of Agricultural Research*, have established, beyond doubt, that the Indian linseed plant is capable of yielding a high quality fibre which may provide a basic raw material for the establishment of a number of industries, such as the textile, paper-making, artificial silk and gun-cotton, etc. These efforts have, therefore, opened up a new field of industrial development in this country and it is hoped that the linseed will become more popular, as the fibre will substantially add to the profits from its cultivation. It has been estimated that Central Provinces and Berar alone will produce nearly 10,00,000 bales of 250 lbs. each annually.

"Slops" of the Mandya Distillery.—The "Slops" on analysis gave the following figures

TABLE I

Particulars	Sample A	Sample B	Sample C
Specific gravity	1·032/26·5° C.	1·035/26° C.	1·03/27° C.
Acidity (as sulphuric) ..	0·76 gms./litre	0·80 gms./litre	1·00 gms./litre
Potash	0·588 gms. %	0·62 gms. %	0·65 gms. %
Phosphate	0·113 ,,	0·13 ,,	0·12 ,,
Nitrogen	1·01 ,,	1·12 ,,	1·05 ,,
Unfermented sugar	0·04 ,,	0·06 ,,	0·05 ,,
Ethyl alcohol	0·004 ,,	0·005 ,,	0·004 ,,
Residue on evaporation ..	6·0 ,,	6·7 ,,	6·5 ,,

(Table I) which indicate that they serve as a source of fertiliser for the Irwin Canal area. The Distillery produces about 24,000 gallons of slops in a day. Hence the amount of potash, phosphate and nitrogen available are 2,700 lbs., 523 lbs. and 4,617 lbs. respectively. The acidity of the wash does not matter if the soil is alkaline which is the case in the Irwin Canal area. Hence the Distillery slops could be very well used as a source of fertilizer for the sugar-cane area.

G. NARASIMHA IYENGAR.

Agricultural Alcohol for Motor Fuel.—A nine-page mimeographed publication (No. 886) issued by the *National Research Council* at Ottawa under the title "Agricultural Alcohol for Power Production", deals with the important aspects of alcohol as a source of power. The publication presents data on the quantities of alcohol used for power production in a number of European countries. It outlines the advantages that would accrue to Canada and sets out the economic arguments for and against the encouragement of the use of alcohol as a component of motor fuels. A short discussion of the methods of manufacture and distribution is followed by an account of the progress in other countries in the utilization of alcohol as a motor fuel. This account shows that large sales of alcohol for power purposes have occurred *only* where there is some legal compulsion. In European countries there are heavy import duties on gasoline and home-produced alcohol is exempted from taxation to allow it to compete with gasoline as part at least of the motor fuel supply.

Tin and Its Uses.—The fourth issue of "Tin and Its Uses" announces a new "white-bronze" plating which out-rivals chromium in its resistance to tarnish and is almost identical in colour and reflecting power to perfectly polished silver. Photographs are reproduced which illustrate the brilliance and other attractive qualities of this new finish on spoons, taps, metal tea-sets and car fittings, and it is suggested that it will also find extensive applications in reflectors for optical instruments, headlamps, etc., unbreakable shaving mirrors; shop fittings, and many other ornamental metal wares.

Thick and adherent tin linings can now be applied to large pieces of apparatus used in the food industry, the Review states, as a result of recent improvements in electroplating technique. These thick linings are far more serviceable than the old hot-dipped coatings. Still another application of electro-deposited tin is as a coating on metal surfaces in rubbing contact, such as pistons and piston-rings and bearing surfaces. The tin not only improves lubrication but also eliminates abrasion during running-in processes.

Cotton-Jute Fabric.—Preliminary trials under actual service conditions with Cotton-Jute Union fabric, which is intended to replace flax, have already indicated its suitability for defence and civil purposes. The threatened shortage of flax, 70 per cent. of which comes from Russia and the rest from the Baltic countries, led to a search for substitutes and thanks to the developmental work of the Department of Supply and the Master-General of the Ordnance of the Government of India, the cotton-jute fabric was evolved.

* * *

SEISMOLOGICAL NOTES

March 1940.—During the month of March 1940, three slight and two moderate shocks were recorded by the Colaba seismographs as against seven slight, one moderate and one great shock recorded during the same month in 1939. Details for March 1940 are given in the following table:—

Date	Intensity of the shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus
1940		h. m.	miles		miles
March 19	Slight	10 05·9	1170	Hindukush mountains	..
,, 21	Slight	19 23·2	3010	..	..
,, 27	Moderate	18 01·3	5890	..	..
,, 28	Slight	00 45·8	1610	..	..
,, 28	Moderate	21 18·8	3230	10° N., 120° E. (Sulu Sea, off the Philippine Islands)	150 (appr.)

ASTRONOMICAL NOTES

Planets during May 1940.—The only planet favourably placed for observation during the month is Venus which continues to be a brilliant object, conspicuously visible in the evening sky. It is slowly approaching the Sun and at the same time its brightness is increasing. On May 20, the planet will be at its greatest brilliancy when its stellar magnitude is −4·2. At about this time, it can be seen with the naked eye even during the day, if the observer knows beforehand its approximate position in the sky. Mars is moving eastward in the constellations Taurus and Gemini and, although decreasing in brightness, will be visible in the evening sky as a ruddy star of the second magnitude. It will set about three hours after the Sun. Jupiter and Saturn will be morning stars and, being close to the Sun, are not well situated for observation.

Nova Monocerotis.—This nova which was mentioned in last month's report, appears to be very slowly fading; an observation of April 8 indicates its magnitude to be 10·1. Some details of the star are given in U.A.I. Circular 808. From an examination of the photographs of the region taken at Sonneberg prior to the outburst, Dr. Hoffmeister concludes the nova to have been a star of the 16th magnitude, subject to some small fluctuations in brightness.

Distance of the Centre of the Galaxy.—There are certain regions close to the plane of the Milky Way where a large number of external galaxies are found. These have been called galactic "windows"—regions where very little space absorption can exist. A study of the cepheid variables in these fields is useful in obtaining reliable estimates of galactic dimensions. The variables in one of such areas have been investigated by Prof. Shapley (H.R. 158) and a new determination of the distance of the galactic centre has been obtained. The computed distance is 9,700 parsecs which appears to agree fairly well with the estimates derived by methods based on different considerations.

T. P. B.

MAGNETIC NOTES

March 1940.—Magnetic conditions during the month were much more disturbed than those in the previous month. There were 2 days each of *very great* and *great* disturbances, 6 of *moderate* disturbance and 12 of *small* disturbance as against 1 of great disturbance, 2 of moderate and 24 of slight disturbance during March 1939. The number of quiet days during March 1940 were 9 as against 4 during the same period of 1939.

The most disturbed day during the month was the 24th, while the quietest was the 15th. The distribution of dates of different characters, is shown in table below.

Quiet days	Disturbed days			
	Slight	Moderate	Great	Very great
4–7, 10, 11, 15, 17, 22	1–3, 8, 9, 13, 14, 16, 18, 21, 27, 28	12, 19, 20, 23, 26, 30	29, 31	24, 25

There were three magnetic storms during the month of which 2 were of great intensity and one of very great intensity, as against two storms, one of great intensity and the other of moderate intensity which occurred during the month of March 1939. The storm of very great intensity occurred on March 24, 1940, and caused considerable interruption to telegraphic traffic all over the world. A detailed description of this storm appears elsewhere in this issue.

The mean character figure for the month is 1·03 as against 0·97 for March of last year.

M. R. RANGASWAMI.

ANNOUNCEMENTS

A limited number of copies of the photogravure reproduction of the portrait of **Sir Frederick Gowland Hopkins, O.M.**, painted for the *Royal Society* by Mr. Meredith Frampton, A.R.A., is available and the *Royal Society* believe that many friends and admirers of Sir Frederick Gowland Hopkins will welcome the opportunity of acquiring these at a price barely covering the cost of the extra printing and delivery. Those requiring a copy should apply to the Assistant Secretary, The Royal Society, Burlington House, London W. 1., with a cheque or Postal Order for 2 *Shillings*. Not more than one copy will be supplied to one applicant.

It is proposed to hold the **Seventh International Congress of Agricultural Industries** in Rome in 1942. Further information regarding the Congress will be published in due course.

The **Association of Surgeons of India** offers an annual prize of Rs. 100 to the best essay based on original work on a selected subject. The subject for 1940 is:—"BLOOD CHANGES IN SURGICAL INFLAMMATIONS." The competition is open to all qualified medical practitioners registered in India, who have been in practice for *not more than 10 years* after qualification.

The essay should reach the Secretary before the 1st December 1940.

Further details regarding the prize can be had from the Secretary, *Association of Surgeons of India*, Binfield, Kilpauk, Madras.

Those interested in cotton research will be glad to know that **Dr. H. C. Harland** is now in Peru, S. America. His present address is Dr. H. C. Harland, Director, Institute of Cotton Genetics, Sociedad Nacional Agraria, Lima, Peru.

* * *

We acknowledge with thanks the receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 51, Pt. 3.
"Journal of the Royal Society of Arts," Vol. 88, Nos. 4552–56.
"The Philippine Agriculturist," Vol. 28, No. 10.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 31, No. 2.
"Allahabad Farmer," Vol. 14, No. 2.
"Biochemical Journal," Vol. 34, Nos. 1 and 2.
"Biological Reviews," Vol. 15, No. 1.
"The Journal of Chemical Physics," Vol. 8, No. 2.
"Journal of the Indian Chemical Society," Vol. 17, No. 1.
"Chemical Products," Vol. 3, Nos. 3 and 4.
"Experiment Station Record," Vol. 82, Nos. 1 and 2.
"Indian Forester," Vol. 46, Nos. 3 and 4.
"Transactions of the Faraday Society," Vol. 36, No. 227.
"Indian Farming," Vol. 1, No. 2.
"The Review of Applied Mycology," Vol. 19, No. 2.
"The Bulletin of the American Meteorological Society, Vol. 21, No. 1.
"Indian Medical Gazette," Vol. 75, No. 3.
"Nature," Vol. 145, Nos. 3667–72.
"Occasional Notes," No. 7 (Dec. 1939).
"Sky," Vol. 4, No. 4.
"Science Forum," Vol. 5, No. 1.

ACADEMIES AND SOCIETIES

Indian Association for the Cultivation of Science: (Proceedings)

December 1939.—S. M. MITRA: *Raman Effect in arsenates and heat of dissociation of AsO.* SACHINDRAMOHAN MITRA: *On the influence of foreign substances on the absorption of the dyestuffs in solution.* RAJENDRALAL DE: A weak Radio-active substance (preliminary note). N. S. PANDYA AND P. D. PATHAK: *A note on the maintenance of electron emission on Cossor Valves after the low Tension supply is disconnected.* G. P. DUBE AND H. K. DAS GUPTA: *On the London-van der Waals forces between two disc-like particles.* D. S. SUBRAHMANYAM: *Pressure waves and boundary surfaces in the free atmosphere.* (MISS) ASIMA MOOKERJEE AND JAGANNATH GUPTA: *Raman Spectra of Coumarins and chromones.* S. K. KULKARNI JATKAR: *Supersonic velocities in gases and vapours.* MD. SALARUDDIN AND B. G. NARAYAN: *Unusual Solar Activity.*

Indian Academy of Sciences:

March 1940. SECTION A.—M. AKRAM, R. D. DESAI AND A. KAMAL: *Studies in naphthalene series—Part I. Some properties of 2-acetyl-1-naphthol and the synthesis of 2-ethyl-1-naphthol.* N. A. CHOUDHRY, R. D. DESAI AND G. S. SAHARIYA: *Studies in naphthalene series—Part II. The synthesis of the* trans*-form of* trans*-decalin-2-carboxy-3-acetic acid.* M. AKRAM AND R. D. DESAI: *Studies in naphthalene series—Part III. Properties of 4-acetyl-1-naphthol and the preparation of 4-ethyl-1-naphthol. Part IV. The preparation and properties of 2 : 4 diacetyl-1-naphthol and 2-acetyl-4-propionyl-1-naphthol.* M. R. ASWATHANARAYANA RAO: *Investigations on the iodide of sulphur—Part I. Formation of sulphur mono-iodide. Part II. Rate of decomposition and spectroscopic studies.* Sulphur mono-iodide is formed in carbon tetrachloride solutions, when a dilute solution of sulphur chloride is treated with solid potassium iodide. The

sulphur iodide is decomposed by light and heat, but is comparatively stable at low temperatures. M. R. ASWATHANARAYANA RAO: *Thionyl iodide—Part I. Formation of thionyl iodide. Part II. Rate of decomposition and spectroscopic studies.* Thionyl iodide is made in carbon tetrachloride solutions by shaking a dilute solution of thionyl chloride with solid potassium iodide. The thionyl iodide is extremely unstable in presence of light. L. RAMACHANDRA ROW AND T. R. SESHADRI: *Synthetical experiments in the benzopyrone series—Part II. Synthesis of flavono- and coumarino-7 : 8-furan-β-ones and their derivatives.* K. SUNANDA BAI: *Raman Spectra of some carboxylic acids.* Isobutyric, benzoic, cinnamic and lactic acids as well as ethyl lactate have been studied. Changes in Raman spectra with temperature and state of aggregation have been investigated. B. DAYAL SAKSENA: *Raman effect and crystal symmetry.* Using a purely geometrical reasoning, it has been possible to write the tensor components for all vibrations belonging to any point-group of the crystal classes. The results are compared with the experimental data in sodium nitrate and good agreement between theory and experiment is observed.

March 1940. SECTION B.—(MISS) P. R. PARUKUTTY: *The myxophyceae of the Travancore State, India.* C. SURYAPRAKASA RAO: *The myxophyceae of the Delhi Province, India—I.*

Indian Chemical Society:

December 1939.—PRIYADARANJAN RAY AND PHANINDRA NATH BAGCHI: *Complex compounds of Biguanide with Bivalent Metals—Part I. Copper Biguanidines.* PRIYADARANJAN RAY AND NIHAR KUMAR DUTT: *Complex compounds of Biguanide with Tervalent Metals—Part VI. Cobaltic* tris*Biguanidines.* PRIYADARANJAN RAY AND HARIHAR PRASAD BHATTACHARYA: *Complex compounds of biguanide with tervalent metals—Part VII. Cobaltic* tris*Phenylbiguanidines.* B. N. GHOSH AND P. C. ROY: *Comparison of the Cataphoretic and Electro-osmotic methods of measuring electrokinetic potential.* DUHKHAHARAN CHAKRAVARTI AND JYOTIRMOY DUTTA: *Synthetical experiments in the Pyrone series. Attempted oxidation of chromanones with selenium dioxide—Part I.* P. M. BARVE, V. C. VORA AND B. N. DESAI: *Mutual coagulation of colloidal solutions. Interaction of copper ferrocyanide with ferric hydroxide, thorium hydroxide and ceric hydroxide.* PRODOSH CHANDRA ROY CHAUDHURY: *Chromium chromate.* BAIDYANATH GHOSH: *Vitamin C and Toxins—Part IV. The Effect of tetanus toxin on vitamin C metabolism.* K. M. CHAKRAVARTY: *Catalytic formation of methane from carbon monoxide and hydrogen—Part VI. On the poisoning by carbon deposition.* JAGDISH SHANKER, PRABHAKAR N. BALJEKAR AND MATA PRASAD: *Space group determination of the crystals of melamine.* P. C. MITTER AND PHANINDRA CHANDRA DUTTA: *Studies in long-chain acids—Part II. On aleuritic acid (I).* (LATE) N. W. HIRWE AND K. N. RANA: *On chloral-amides. The reaction of phosphorus pentachloride on chloral-chlorosalicylamides and their methyl ethers and the reactivity of the chlorine atom.* G. GOPALA RAO AND W. V. SUNDARA RAO: *Mechanism of the microbiological oxidation of ammonia—Part II.*

January 1940.—BAWA KARTAR SINGH AND TARA PROSAD BARAT: *Studies on the dependence of optical rotatory power on chemical constitution—Part XVII. Nitro and Carboxyaryl derivatives of stereoisomeric methylenecamphors.* MUHAMMAD QUDRAT-I-KHUDA AND SUBASH KUMAR GHOSH: *Stereochemistry of monocyclic rings—Part I. Interconversion of methylcyclohexane into methylcycloheptane ring and synthesis of 4-methylcycloheptanone.* H. A. SHAH AND R. C. SHAH: *C-alkylresorcinols—Part IV. Nuclear methylation of 4-acyl-resorcinols.* S. M. SETHNA AND R. C. SHAH: *Pechmann condensation of methyl β-resorcylate with some β-ketonic esters.* H. A. SHAH AND R. C. SHAH: *Furano compounds—Part I. Synthesis of Furo-3'-methyl-5 : 6-(4' : 5)-coumarin and Furo-3-ethyl-5 : 6(4' : 5')-coumarin.* PRAFULLA KUMAR BOSE AND PHANIBHUSHAN DUTT: *Natural flavones—Part IV. On the constitution of erianthin, the yellow colouring matter of* Blumea eriantha *DC.* PRAFULLA KUMAR BOSE AND SACHINDRA NATH DUTT: *Investigation of the oil from the fruits of* Ferula alliacea, *Boiss.* W. V. BHAGWAT: *Application of Beer's Law of Absorption to solutions.* S. S. DESHPANDE, W. V. BHAGWAT AND C. W. SUBNIS: *Velocity of transformation of 1 : 3 : 5-triketones into 2 : 6-disubstituted γ-pyrones—Part I. Velocity of transformation of acetone dioxalic ester into chelidonic ester.* DUHKHAHARAN CHAKRAVARTI AND NARENDRALAL DUTTA: *Synthesis of coumarins from o-hydroxyl-aryl-alkyl ketones—Part III.*

Meteorological Office Colloquium, Poona:

March 5*th.*—DR. K. R. RAMANATHAN: *Ozone and its distribution in the upper atmosphere.*

March 12*th.*—MR. C. RAMASWAMY: *On Deppermann's memoir on some characteristics of Philippine Typhoons.*

March 19*th.*—DR. S. K. BANERJI: *Criteria for stability of the atmosphere from Dynamical considerations.*

ERRATA

Vol. 9, No. 3, March 1940:—

(1) Contribution entitled "Calcium Utilisation from Green Leafy Vegetables", p. 124, second column, first line: *For* "the skim milk", *read* "its".

(2) Contribution entitled "Kostanecki Acylation of Orcacetophenone", page 118, lines 13 and 14: *For* "Orcacetophenone and its monomethyl ether on benzoylation gave", *read* "Orcacetophenone on benzoylation gave".

'40—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore.